

OBITUARY NOTICES  
OF  
FELLOWS DECEASED.

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## C O N T E N T S .

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## SIR WILLIAM HENRY POWER (1842-1916).

Sir WILLIAM HENRY POWER, K.C.B., Principal Medical Officer of the Local Government Board from 1900 to 1908, died on July 28, 1916, at his residence at East Molesey after a lingering illness. He was in his 74th year, having been born in London, December 15, 1842. His father, Dr. William Henry Power, who died in 1877, apart from his strictly professional work, had earned a remarkable reputation as a successful medical coach in the various subjects for the diplomas of the Royal College of Surgeons and of the Apothecaries Company. It is of interest to note that the following of medicine as a career was hereditary in the family to a somewhat unusual degree, Sir William Power being the fifth representative of the profession in direct succession from father to son, the first of the medical line having been John Power (born in 1730), who practised as a surgeon at Polesworth in Warwickshire.

As bearing on Sir William Power's devotion to exact methods of research it may be noted also that evidence of hereditary devotion to mathematical studies is afforded by the fact that his uncle, John Arthur Power, and at least four other relatives on the paternal side graduated at Cambridge as Wranglers and became Fellows of their respective Colleges; one of them, John Power (1818-1880), who was 8th Wrangler in 1841, eventually becoming Master of Pembroke College, Cambridge, and Vice-Chancellor of the University.

Power received his early education at University College School, subsequently commencing his medical career in the manner then usual by being apprenticed to his father, and entering as a medical student at St. Bartholomew's Hospital. He obtained the qualifications of M.R.C.S. and L.S.A. in 1864, and during the next six years held various hospital appointments, of which a somewhat prolonged tenure of that of Resident Medical Officer to the Victoria Park Hospital for Diseases of the Chest afforded him the opportunity for obtaining an intimate practical knowledge of the various clinical and pathological phases of tuberculosis, of which he availed himself to the utmost. He always retained special interest in the study of this disease, more especially in relationship to public health work, and the results of this early training, coupled with his intuitive appreciation of the various problems requiring solution and of the methods of scientific investigation best suited for their elucidation, proved most valuable, more especially during his term of service on the Royal Commission on Tuberculosis.

In 1871 Power commenced his long official career in Public Health on appointment as Temporary Medical Inspector to the Local Government Board, to which the Medical Staff of the Privy Council had been transferred on the formation, in that year, of the new Department. Of his colleagues at this period no less than four, John Simon, Seaton, Buchanan, and Thorne, as in the case of Power himself, subsequently became in turn Principal Medical Officer to the Local Government Board. Of this pioneer staff, which also

included Netten Radcliffe and Ballard, Sir John Simon has pithily stated the aim and objects in the following words: "I believe we had the credit of earnestly endeavouring to learn the truth, and tell the truth, as to the matters which our enquiries regarded."

In the course of 16 years' service as Medical Inspector Power carried through an immense amount of more or less routine work, including enquiries into the sanitary circumstances and administration of various urban and rural districts. In addition he investigated and reported on a number of outbreaks of infectious diseases, more particularly small-pox, diphtheria, and scarlet fever, as to which some brief account must be given in view of the importance of the discoveries made, and of their bearing on epidemiology and preventive medicine.

For instance, while investigating the incidence of small-pox in the area surrounding the Fulham Hospital in 1881 and subsequently in 1884-1885, Power found that admission of cases of this disease into the hospital at certain periods was followed after regular intervals of time by the occurrence of cases of small-pox in the surrounding district. He demonstrated, moreover, the fact that if a circular area extending outwards from the hospital as a centre, to a distance of a mile, was divided into zones drawn upon the map having radii of  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1 mile respectively, and an enumeration of all the houses in each zone were made and also of all houses invaded by small-pox, the percentage of invaded houses in each zone diminished as the distance from the hospital increased and, further, that this relation held good in each quadrant of each zone. Within the quarter-mile zone there was but one approach to the hospital, this being in the north-west quadrant. This being so, the distribution of the cases showing exceptionally heavy incidence in the south-west quarter-mile quadrant was not such as to suggest any relationship to lines of traffic or ambulance routes. Studying the observed phenomena more closely, Power concluded that diffusion of small-pox only occurred subsequent to the aggregation of acute cases in the hospital, and probably also only during prevalence of certain atmospheric conditions, the effect of which, however, seemed to vary somewhat from one season to another.

Finally he directed attention to the fact that statistics of small-pox incidence in the registration districts of London during the years 1876 to 1885 afforded demonstration that the local distribution and intensity of small-pox during the epidemics which had occurred during that period had been definitely influenced by the proximity or otherwise of the London small-pox hospitals. He pointed out, moreover, that such relationship tended to become specially marked in the event of any new hospital situated in a district up to that time comparatively free from small-pox having to be opened for the reception of acute cases of the disease. This now classical exposition of the danger to the public health incidental to the aggregation of cases of small-pox formed the basis of legislative action which resulted in the removal of small-pox hospitals out of the Metropolitan area.

Power was the first to direct attention (in 1878) to the possibility of the

dissemination of diphtheria from the consumption of milk. His report to the Local Government Board on an "Epidemic Prevalence of Diphtheria in North London," dated December, 1878, contains a lucid account of the line of reasoning which led him to the conclusion that milk was capable of acting as a medium for the conveyance of diphtheria infection to the human subject. Although the source of infection of the milk itself was not traced, demonstration in detail was afforded that the disease had been conveyed along with milk distributed by a particular dealer serving the affected area.

In 1882 Power, as the result of inquiry into an outbreak of scarlet fever in St. Giles and St. Pancras, demonstrated a similar relationship between the consumption of infected milk and the spread of scarlet fever; suggesting, moreover, the possibility that milk-borne scarlet fever might be due to a disease of similar character in the cow rather than to contamination of the milk from a human source.

His investigation of a sudden and extensive outbreak of this disease which occurred in Marylebone and certain other districts in December, 1885, carried the matter a stage further by the interesting and important discovery that cows suffering from a vesicular disease of the teats and udder constituted the actual source of infection.

Towards the end of the nineteenth century it became apparent that the water supplied for drinking purposes in various areas, in Yorkshire particularly, was responsible for the causation of more or less extensive outbreaks of lead-poisoning. The occurrence of a number of deaths among affected individuals naturally directed attention to the special circumstances, and it shortly became obvious that, in every instance, it was specially soft water of acid reaction, derived from moorland gathering grounds, and delivered under high pressure, that alone was capable of dissolving lead, sometimes in considerable amount, from the local service pipes.

So soon as information resulting from preliminary investigation of certain of these outbreaks became available, Power, who evinced much interest in the matter, at once realised that factors, in all probability hitherto overlooked, or non-existent, must have come into play. To him it is that we owe the original suggestion that the acidity to which it appeared that the plumbo-solvent action of soft moorland waters was due, was in turn dependent on the presence in the water of low forms of organic life. He further suggested that these might find their necessary pabulum in the peaty material abundantly produced on the gathering grounds from which such waters are derived. And it was at his instigation that to Dr. Houston, now Director of Water Examinations to the Metropolitan Water Board, was entrusted an experimental inquiry on the subject of acid-producing bacteria in these moorland waters, and, further, of the plumbo-solvent action of the acid produced by the bacteria in culture media. As an outcome of this and other investigations on the subject, of which one at least owed much to Power's valued suggestions and kindly criticism, simple methods have been devised for neutralising the action of any acids present in the water, with the result

that outbreaks of lead-poisoning from drinking-water in this country are now practically unknown.

Reference must also be made to an aspect of Power's prescience in public health work which would appear hitherto to have been in large measure overlooked. As a matter of fact he was a pioneer in the investigation of the causes and possible prevention of infantile mortality, a subject which has bulked so prominently before the public of late years, and in reference to which, at the time of writing, further legislation is being sought from Parliament at the instance of the President of the Local Government Board.

Early in his official career, he was associated with the late Dr. Ballard in the investigation of mortality from diarrhoea among infants and young children; while in 1876 he was himself entrusted with inquiry into exceptionally fatal prevalence of this disease at Winchester. Here he found that, as in previous outbreaks, the majority of the cases came under observation in the third quarter of the year, while the incidence and mortality was almost entirely confined to children under five years of age. In view of the fact that, in other towns, excessive mortality from diarrhoea had been "found coincident with tainting of the atmosphere with the products of organic decomposition, especially of human excrement," detailed inquiry was made at Winchester as to the possible influences of similar conditions, while various social circumstances of the population (including the care and feeding of infants) were brought under review. As the result of his investigations Power was greatly impressed with the general helplessness and want of knowledge often exhibited in the upbringing of infants; and the need, with a view to safeguarding their elementary right to a chance of survival, for intelligent guidance and guardianship on the part of the State.

As the outcome of further study of the subject he realised the necessity for obtaining more accurate classification of the ages at which death occurred in the case of infants failing to survive for three months after birth, and with this object in view, shortly after being appointed Medical Officer to the Local Government Board, he took steps to procure periodical special returns of infant mortality from Medical Officers of Health throughout England and Wales.

Recognising also the need for detailed information as to the causes from which young infants perished, as well as their precise ages at death, it was mainly at his instigation that in the Registrar-General's Report for 1905 infantile deaths for the first time were classified as supervening at the following ages:— Under 1 week old, aged 1–2 weeks, 2–3 weeks, 3–4 weeks, 1–2 months, 2–3 months, and so on, up to 11–12 months.

Power had previously placed on record the disconcerting fact that, despite the application of science to the problems affecting public health, the amendment of the law with the object of furthering improved sanitary administration on the part of local authorities, and securing more adequate control of defaulting local authorities on the part of the Central Administration, the death-rate from "all causes" of children under one year old had, on

the whole, remained practically unaltered for more than half a century, whereas the "all causes at all ages" rate had undergone steady reduction during the same period.

In this connection, moreover, he directed attention to the remarkable fact that if only the "all causes" infantile death-rate in England and Wales had improved *pari passu* with the death-rate for "all causes at all ages," this would have meant, during the quinquennial period 1898-1902 for instance, a saving of the lives of no less than 120,000 infants over and above those who actually survived; in other words, that there had been a loss of infant lives, from causes in all probability largely preventable, to the extent of no less than 24,000 per annum.

In this, as in other problems engaging his attention from time to time, he had no sooner elucidated to his satisfaction what appeared to constitute the main factors concerned in the annually recurring "slaughter of the innocents" than he set himself the further task of determining the lines along which progress might be expected to conduce to improved expectation of life in the case of infants, whether newly born or of later age. His recommendations to this end laid special stress on the necessity of the breast-feeding of infants or, where this was impracticable, or the child was already weaned, on the use of cows' milk the purity of which was ensured so far as possible by supervision of all the circumstances attending its production and distribution.

Among further recommendations he directed attention to the injurious effects likely to ensue on defective environment such as over-crowding and other conditions incidental to unsanitary housing accommodation. Remedial measures advocated by him, which have since received the endorsement of legislative enactments, include the notification of births, the training and appointment of health visitors, the co-ordination of voluntary organisations for Infant Welfare under the general supervision of the medical officer of health, and the control of milk supplies as well as, incidentally, other food supplies which are of essential importance to infants.

During his long connection with the Local Government Board he planned and directed a large part of the work of the Medical Department, including that comprised in the "Auxiliary Scientific Investigations" of which he was placed in charge when still a Medical Inspector, while of the numerous reports dealing with matters concerning the public health issued during his period of service many were either written by him or owed much to his editorial criticism and supervision. Nevertheless it is a somewhat curious fact that, owing to his retiring disposition, he was comparatively little known outside official circles. Indeed, his horror of publicity in any form or shape was so intense that he would neither attend meetings at which he might be called upon to speak, nor would he be photographed. The usual reference books knew him not, and even the 'Medical Directory' contained the barest modicum of information concerning him, until (almost certainly without his knowledge) the matter was taken in hand by one of his colleagues in the Medical Department.

As so felicitously expressed by Dr. McVail, on the personal side Power had a rare gift of friendship. His qualifications included a never-failing readiness to appreciate a point of view different from his own, and to throw his whole mind into the consideration and discussion of a question which was occupying the other man's thoughts. He used to say that, officially, his brain was a kind of gland through which all sorts of material had to pass for rejection or acceptance and digestion, and his half-amused grumble was that often it had not finished dealing with one substance before another was forcibly thrown into it. But this natural or acquired capacity for considering the most varied problems was always at the service of others, while the value of his help and criticism was enhanced by the remarkable faculty he possessed for mastering the principles and application of sciences which had been non-existent, or in a comparatively elementary stage, during his student days.

During his tenure of the post of Assistant Medical Officer, to which he was promoted in 1887, it became a well-recognised custom for any of his junior colleagues who might be at the office to drop into his room for half-an-hour or so after lunch, when, aided by the soothing influence of tobacco, opportunity was afforded for informal discussion of any points of interest or difficulty in connection with official work. Occasionally the conversation would take on a lighter or more personal tone.

The recollection of these gatherings and of Power's genial presence, quiet sense of humour, and keen interest in the doings of those who, in public health matters at any rate, were in a very real sense his pupils, will never be likely to fade from the memory of any of those now surviving who were privileged to participate in them.

In spite of frequent illnesses, due especially to attacks of influenza, he was a tireless worker and, as testified by an intimate friend, even insomnia was utilised as affording time to continue his labours. "The night cometh, when a man *can* work," was his explanation of how he accomplished so much, and his daily journeys from and to his house in Kent, or later on, in Surrey, were devoted to official papers. Only with the greatest difficulty could he be induced to take a holiday, owing mainly to an impression on his part that he was specially liable to attack by illness of some sort on his return to duty. Yet, as might have been gathered from his fine physique, he was something of an athlete in his youth, excelling in cricket and shooting, as well as in the navigation of a sailing yacht, his love for which pastime persisted to his later years.

Greatly devoted also to the study of Natural History, Power throughout an exceptionally busy life was wont to devote to this subject much of the scanty leisure at his disposal. And there can be little doubt that it was to his knowledge of Natural History that he owed the inspiration which resulted in his initiation of original lines of investigation, more particularly in regard to the possible and probable inter-relationship of disease of man and animals, to which reference has already been made. His special interest, however, lay in the systematic study, so far as available opportunities permitted, of the

migratory habits of birds, concerning his observations of which he had kept records from 1858 onwards.

With his brother, Mr. F. D. Power, he gathered together the greater portion of a collection commenced by his father in 1840 and now housed by his cousin, Mr. Charles Cowper Mee, at Oldbury Hall, near Atherstone, Warwickshire, which includes no less than 250 groups of specimens of British birds. But he had no love for the mere annexation of specimens, and, equally, no sympathy with those who by indiscriminate shooting frightened birds away, and so disturbed the observations on which he was engaged. Among the specimens contributed to the collection by Power between the years 1862 and 1916, of which many were prepared by himself, certain specially rare examples, including a female hen harrier (*Falco cyaneus*) shot November, 1864; a merlin (*Falco aesalon*) shot in Kent, November, 1881; a specimen of a glaucous gull (*Larus glaucus*) captured at Stiffkey, Norfolk, November, 1887; and a garganey (*Anas querquedula*) shot, December, 1887, may be of interest to ornithologists.

Towards the end of his life, when physically incapacitated by illness, he still derived much pleasure from observing, with the aid of field glasses, and making notes as to the movements of birds that he could see from his garden at Molesey—swifts, swallows, martins, sand-martins, blackbirds, thrushes, willow-wrens, various tits and the black-headed gulls passing to and fro from Molesey Reservoir.

On the retirement of Sir George Buchanan in 1892, Power became First Assistant Medical Officer to the Local Government Board, succeeding to the post of Principal Medical Officer eight years later, on the death of Sir Richard Thorne.

In 1904, during his tenure of office as head of the Medical Service of the State, the Food Department was established on his initiative. He had long foreseen the value and importance to the country of the work possible of accomplishment as the result of such an expansion of the energies of the department under his control, and it will be generally admitted that his prevision has been amply justified, more particularly during the present war.

While Medical Officer to the Local Government Board, he also served, as Crown nominee, on the General Council of Medical Education, on the Royal Commission on Sewage Disposal, and on the Royal Commission on Tuberculosis, of which he subsequently became Chairman on the death of Sir Michael Foster.

He received the C.B. in 1902 and the K.C.B. in 1908, on retirement, at the official age limit. He was elected a Fellow of the Royal Society in 1895, and in 1907 was awarded the Buchanan Medal. Other honours awarded him include the Jenner Medal of the Epidemiological Society, the Bisset-Hawkins Medal of the Royal College of Physicians of London, the Stewart Prize of the British Medical Association, the Honorary Fellowship of the Royal College of Surgeons of England, and the Freedom of the Apothecaries Company.

Power will perhaps be best remembered for the somewhat unique faculty

he possessed of communicating much of his own enthusiasm for research, and of his special genius for concentration on the essential details of whatever investigation he had in hand, to each of the fellow-workers with whom he successively came in contact. His, moreover, was a charming personality, which endeared him to all his colleagues, many of whom benefited to no small extent from his kindly help and encouragement, always so readily accorded. As regards his official work, it is not too much to say that no man in this country has done more than Sir William Power to advance the cause of scientific hygiene.

S. M. C.

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CLEMENT REID, 1853–1916.

CLEMENT REID was born on January 6, 1853. His father was a goldsmith, and, as one of a large family, the subject of our memoir was compelled to depend upon his own exertions and at an early age entered a publisher's office, where he remained for six years. The work was distasteful to him, but in later life he acknowledged that he had benefited from the business training. His love for Nature was innate and as was appropriate he, a great-nephew of Michael Faraday, had that love intensified by the juvenile lectures at the Royal Institution. He determined to cut himself adrift from a business career and to devote himself to science, and, attracted to Geology, enthusiastically studied with the desire to obtain a post on H.M. Geological Survey. This he gained in 1874 and for nearly 40 years, to the day of his retirement in 1913, he was an officer of that Survey. From the time of his appointment until his death, he sedulously devoted himself to the pursuit of his science, with the success to which his published writings bear eloquent witness.

His work on the Survey began in the South-west of England, but he was soon transferred to the East Coast, and for many years laboured in Norfolk, North-East Yorkshire, Holderness, and Lincolnshire. He then moved south and mapped districts in the South Downs, Sussex Coast, Hampshire, the Isle of Wight, Dorset and Wiltshire. He was appointed District Geologist in 1901 and took charge of the Devon and Cornwall area, and afterwards, until the date of his retirement from the Survey, of the district around London. In 1908 he was sent to Cyprus on an Official Mission in order to advise the Colonial Office on the question of water supply.

Reid was elected a Fellow of the Geological Society in 1875, of the Linnean Society in 1888, and of the Royal Society in 1899. He was awarded the Murchison Fund of the first-named Society in 1886, and its Bigsby Medal

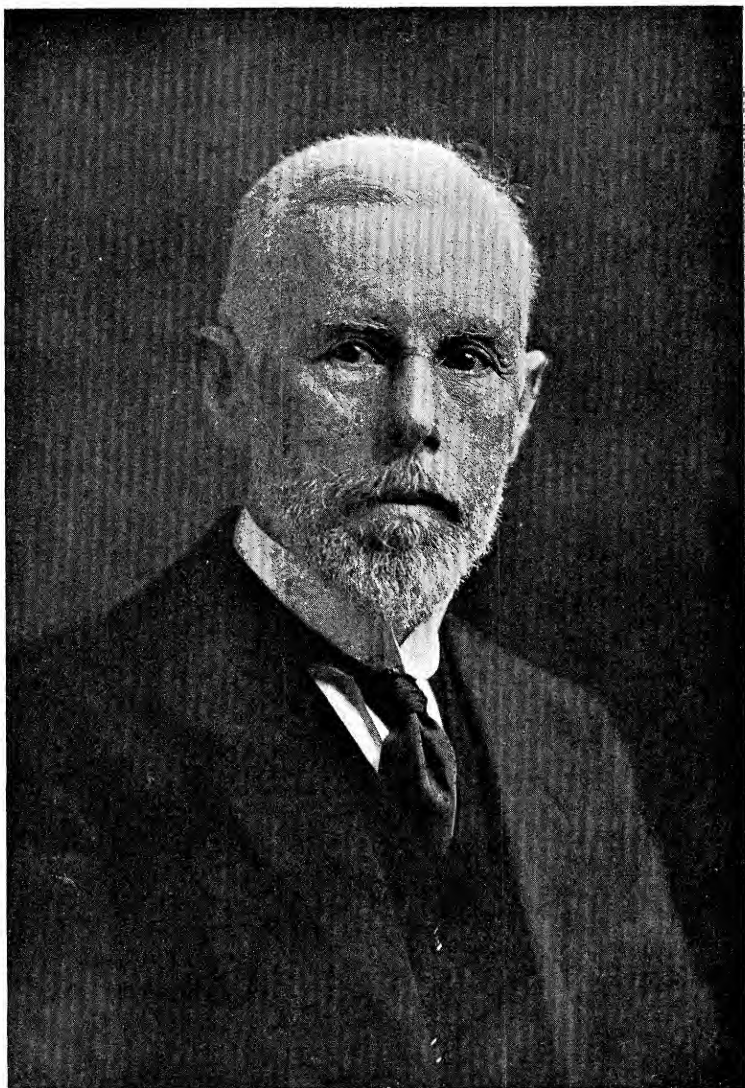


Photo by Elliott & Fry, Ltd.

*Clement Reid*

(1914)

in 1897; he also served for two terms on the Council of that Society and was a Vice-President in 1913-14. He also served for two terms on the Council of the Linnean Society. In 1911 he was awarded the Bolitho Gold Medal of the Royal Geological Society of Cornwall. He was a foundation member of the Société Belge de Géologie, de Paléontologie et d'Hydrologie.

He wrote much and on many subjects, but the work with which his name will be ever associated is that devoted to the Pliocene and Pleistocene deposits of this and other countries, with the consequent illuminating researches into the Pleistocene and later floras. For the conduct of this work he was naturally fitted by a happy combination of biological and geological knowledge, but, in addition to this, he displayed much fertility of invention and high manipulative skill, as evidenced by his published methods of extraction and preservation of plant remains from deposits of varying character.

A keen and accurate observer, he was likewise a sound reasoner, and was particularly averse to drawing inferences unless he felt that they were in the fullest degree justified by the facts. The foundation for much of his later work was laid while surveying on the Norfolk Coast, and the results are embodied in the classical memoir on 'The Geology of the Country around Cromer,' published in 1882. While studying the deposits of the Cromer Forest Bed Series he grasped the importance of the plants of this formation, and applied himself to the study of their seeds and leaves, thus preparing himself for those labours in Late Tertiary palæobotany, which he afterwards carried on, at first alone and then in collaboration with his wife, with eminent success.

When engaged in this work in subsequent years he contributed largely to our knowledge of the various Pliocene and Pleistocene floras of Britain, and, turning his attention to the Continent, gave us, with his wife's co-operation, the important series of memoirs dealing with the Pliocene flora of the Netherlands. In 1899 his knowledge was applied to the elucidation of the flora of these islands in the work entitled 'The Origin of the British Flora.' As one would naturally expect from Reid's two-fold training as naturalist and geologist, his work on the floras has been of great value both to the biologist and geologist. To the latter it has not only furnished evidence for a chronological sequence, but has also thrown much light on climatic changes in the past.

Reid paid much attention to the geological history of mankind, and, among numerous writings on this subject, special mention may be made of his important contribution on the relationship of Palæolithic Man to the Great Ice Age, in the Report on the Hoxne deposits, published in the 'British Association Report' for 1896.

As a stratigraphical geologist, his work ranged over many formations, but was mainly devoted to those of late geological date. The extent of his knowledge is shown by the 'General Memoir on the Pliocene Deposits of Britain,' which was written by him. When preparing this work he visited

Belgium and Italy in order to compare the deposits of those countries with their equivalents in England. Though essentially a stratigraphical geologist and palæontologist he contributed to all branches of geology, and, whatever might be his topic, he displayed his great originality.

He paid little attention to the popularisation of his subject, though eminently capable of the work, as witnessed by his delightful little book on 'Submerged Forests,' written for the Cambridge Series of Manuals of Literature and Science.

Reid was naturally of a retiring disposition, and may have appeared to some difficult of approach, and perhaps too determined in controversy. But those most intimately associated with him knew that this determination was due to his keenness for arriving at the truth. His opinions were ever formed from his own observations, where this was possible, and were not infrequently eminently original, and held with characteristic tenacity. It was not easy to be admitted into his circle of friends, but to those so admitted he gave of his best. They beheld one devoted to his science, giving his whole energy to it, and determined above all things to arrive at the truth. Nor was he so wrapped up in his science that he cared for naught else; an excursion in the field with him was not only an education but also a delight. His kindness was constantly shown by the ever-ready help given to other workers.

When Reid retired from the Geological Survey in 1913, he made himself a home at Milford-on-Sea, in Hampshire, looking forward to a period in which he could follow his bent, free from official duties. He had already done much work in this retreat, and there, among other things, had begun, in co-operation with Mr. J. Groves, a research upon fossil *Charæ*, of which the first results were recently published. The period of retirement, however, was all too short, and he passed away quietly in the new home on December 10, 1916.

J. E. M. and E. T. N.

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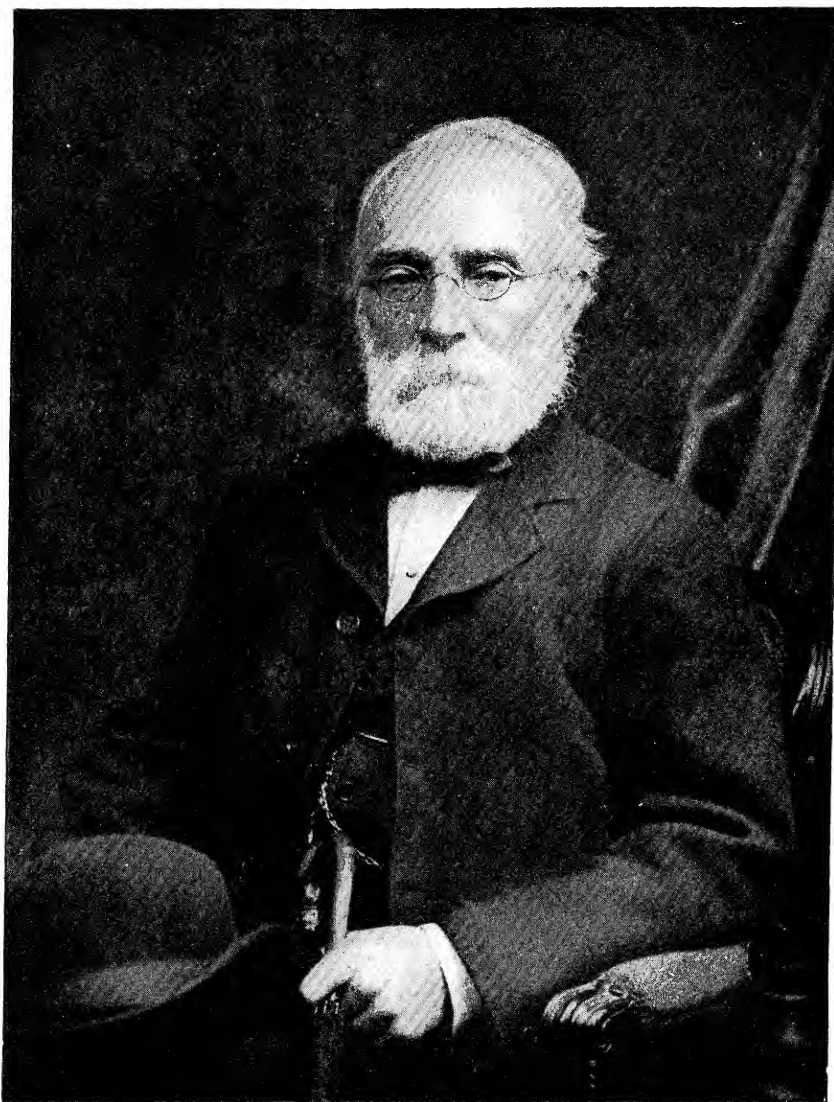


Photo by Mauld & Fox

*Daniel Chivers*

## DANIEL OLIVER, 1830-1916.\*

By the death of Daniel Oliver Kew has lost its senior retired official, whose connection with the establishment began 1858. He was the first to bear the title of "Keeper of the Herbarium and Library," and was appointed in 1864.† He obtained the post through his own initiative. Under date of February 2, 1858, he wrote to Sir William J. Hooker, then Director of Kew, suggesting that possibly there might be an opening as Botanist to a Surveying Expedition, adding: "I venture to express a hope that thou wilt kindly afford me a chance of placing my best services at thy disposal." The result was an invitation to Kew, where he arrived in February, 1858. Deceased was born at Newcastle-on-Tyne on February 6, 1830, and was the son of Andrew and Jane Oliver, of Benwell Hills, members of the Society of Friends.

He was educated at the Friends' School at Brookfield, Wigton, where he early developed a keen interest in the study of Natural History in the field, and soon joined the Tyneside Naturalists' Field Club, now the Natural History Society of Northumberland and Durham. This brought him into contact with Sir Walter Trevelyan, Dr. Embleton and other enthusiastic North Country naturalists. Later Oliver became Lecturer on Botany in the Medical School of the University of Durham, and during these earlier years he made herborising excursions in the northern counties and in Ireland; always with a view to critical study and discovery.

His earliest publication‡ was, I believe, "On a Few Plants found in Bouldersdale and Teesdale, together with the Formations on which they were Found," which appeared in the 'Phytologist,' vol. 2, 1847. This was followed, previous to his going to Kew, by a number of short papers, mostly on British plants. Notable in his early herborisings was the discovery of *Naias flexilis* in Connemara, thus adding a new genus to the Irish and British flora: a fresh-water organism of wide distribution, which has since been recorded within the United Kingdom from Scotland. Meanwhile, in 1851, he had been elected a Member of the Edinburgh Botanical Society; in 1853 he entered the Linnean Society of London, of which Society he was the Father at the time of his death, with six years' seniority over Sir Howard Elphinstone and Sir John Llewelyn, the former of whom followed Oliver less than a fortnight later.

\* This sketch is in part a repetition of my memoir, with portrait, which appeared in the 'Journal of the Kew Guild' for 1898; in part from information kindly supplied by the deceased's family; in part from particulars extracted from the 'Kew Bulletin,' supplemented by my personal knowledge of Prof. Oliver's career.

† His lamented predecessor, A. A. Black, became "Curator" in 1853, and died in India in 1864; but his was not a Civil Service appointment.

‡ A bibliography of Oliver's botanical work is given in the 'Kew Bulletin,' 1917, pp. 32-36.

As already stated, Oliver entered Kew in 1858, when funds were low and Sir William Hooker was struggling in the face of great difficulties to lay the foundation of a scientific botanic establishment, in this he was ably assisted by his son, J. D. Hooker, and Daniel Oliver. At this period Hooker's private herbarium and portions of his unrivalled private library were housed in the old part of the present range of Herbarium buildings, together with the collections and books presented to the nation by George Bentham, William Arnold Bromfield, and others. Dr. J. D. Hooker's Australasian, Antarctic, and Indian collections, as well as those of William Griffith and several other notable travellers, were in process of classification and elaboration. This involved an immense amount of mechanical labour which Oliver took up with untiring energy in return for a mere pittance. In 1859 he inaugurated a free course of lectures on Botany to the young gardeners of Kew Gardens, and this was supplemented in 1860 by instructional evenings devoted to elementary chemistry, electricity, meteorology and meteorological instruments, varied by readings of selections from the Kew correspondence of Gustav Mann, Dr. F. Welwitsch, and others. He continued the lectures on Botany until 1874. The writer's acquaintance and official association with Prof. D. Oliver began in the autumn of 1860, and most of what follows is given from personal knowledge.

Fortunately for Oliver, his meagre Kew stipend was soon augmented in a substantial manner by his appointment in 1861 in succession to Dr. Lindley to the Botanical Chair of University College, London, which he occupied until 1888. During a number of terms I had the advantage of acting as his preparer, for which I was liberally remunerated, besides adding to my very slender stock of general knowledge. In this connection let it be mentioned that every hour, indeed every quarter of an hour, borrowed from his official time at Kew was repaid to a minute. But he was scrupulously conscientious in all things, and a disciplined example to his subordinates in punctuality and other qualities that make an effective and respected leader.

Returning to his published work, after his settlement at Kew ; only a small selection can be noticed. He was the principal contributor on Botany and Assistant Editor of Busk's 'Natural History Review,' 1861-65. It was in this serial that his paper appeared on "The Atlantis Hypothesis in its Botanical Aspect," a paper that created unusual interest at the time. The paper was written in controversion of Heer and Unger's hypothesis that during the Miocene Period there existed an Atlantic junction between Europe and America. Oliver's arguments against this hypothesis were based on known facts of the recent distribution of plants and a critical traverse of Heer and Unger's identifications. Asa Gray's comparison of the floras of eastern North America and Japan is also quoted by Oliver in support of his position. No serious defence of Heer and Unger has been attempted, I believe ; and Unger's 'New Holland in Europa,' of about the same period, was adversely criticised by George Bentham and indirectly by Oliver.

Many of Oliver's papers of great interest on Systematic and Geographical

Botany appeared in the publications of the Linnean Society. Prominent among these are annotated lists of plants collected in various remote and then little known parts of the world, including the mountains of eastern tropical Africa, certain Pacific islands, and the Arctic regions. Of the papers of greater length, the "Botany of Speke and Grant's Nile Expedition," the "Botany of Everard im Thurn's Roraima Expedition," and "List of the Plants Collected by H. B. Guppy in the Islands of Bougainville Straits" are noteworthy examples. Many of these collections were from fresh territories or little known regions and contained numerous highly interesting new generic types, especially West Tropical African and Malayan collections. But, like the herbarium, Oliver's work embraced the phanerogamic flora of the world in all its families, and the more complex or difficult families such as the Olacaceæ, Hamamelidaceæ, Flacourtiaceæ, Utriculariaceæ, and Loranthaceæ, had a special attraction for him. Begonia was a favourite genus, and he had the good fortune to discriminate Begoniella of the Andes and Hillebrandia, peculiar to Hawaii, the only other genera commonly admitted in the Begoniaceæ.

Oliver was author of the first and several succeeding editions of the Official Guide to the Kew Museums and also of the 22nd to the 30th Edition of the Official Guide to the Royal Gardens and Pleasure Grounds, Kew, 1863-85. These, as well as his educational books, are written in simple yet clear language, within the grasp of the multitude. His lectures were equally lucid, though not of an oratorical character. He adopted the deceased Prof. Henslow's type method of teaching Systematic Botany by the use of schedules, and his little book, 'Lessons in Elementary Botany,' embodies the principles of this method, preceded by chapters on Elementary Structural and Physiological Botany. There are many editions of this admirable primer; the first appeared in 1864 and the last in 1910. His 'First Book in Indian Botany' is on similar lines and has run through nine impressions, 1869-1911. His 'Illustrations of the Principal Natural Orders of the Vegetable Kingdom' deserves special mention in this connection. It contains upwards of 100 excellent hand-coloured plates by W. H. Fitch, with dissections and explanatory letterpress. The first volume of Oliver's 'Flora of Tropical Africa' was published in 1868, and the work was advanced by him, assisted by other Botanists, to the third volume, in 1877, when stress of other official work and lack of assistants prevented its continuation.

For a number of years Oliver edited and was almost sole contributor to Hooker's 'Icones Plantarum,' in which he published many novelties detected in various collections from nearly all parts of the world, including A. Henry's earlier discoveries in Central and Western China. I may here relate an incident in this connection. Among A. Henry's novelties were specimens bearing leaves like those of an *Æsculus* and terminal clusters of flowers of the ordinary *Viburnum* structure. This singular combination was described and figured by Oliver as a new genus under the name of *Actinotinus*. Some months later Oliver came upon another puzzle in which papilionaceous flowers

were associated with a type of foliage quite new to the Leguminosæ. He showed the specimens to Mr. N. E. Brown and the writer, and the critical-eyed Brown at once exclaimed "Why, the flowers are inserted in a branch of something different." It flashed across Oliver's brain that John Chinaman had deceived him and he hastened to fetch the specimens of his *Actinotinus*, when the fraud was evident; but it was so cleverly manipulated that it had escaped detection by at least four persons who had handled the specimens. I never before or since saw Prof. Oliver so excited, and I am sure it disturbed his truth-loving soul for days, if not weeks. I am not sure whether he ever knew that I was similarly victimised some years later, when I described the leaves of a *Daphniphyllum* and the flowers of a *Rhododendron* as a new species of the latter genus. But I do know that the same Chinaman tried the same trick with Mr. E. H. Wilson; was detected and mulcted of three weeks' wages.

Allusion has already been made to Oliver's artistic temperament, but nothing has been said of his activity in Art and its development, and how he became acquainted with Ruskin. In 1870 he delivered a course of 10 lectures on Botany at South Kensington Museum, in which the doctrine of "axis and appendages" was expounded. Meeting a lady at tea one day, Ruskin asked her what she had been doing, and she explained that she had attended these lectures, and informed him that the lecturer had stated that there were "seven sorts of leaves, and that there were no flowers." Ruskin used this as his text for a diatribe in '*Fors Clavigera*.' Apparently, Oliver expostulated, for later in the same volume there is an apology. However, the sequel was a friendly visit to Kew and a lifelong friendship as the result.

Oliver's holidays were largely spent in sketching, and his '*Plant and Animal Forms as used by Workmen of the Middle Ages in Decoration, chiefly of French Churches*,' was the outcome of a sample of his work of the period 1882-86. The selection consists of 50 large quarto sketches, privately reproduced in lithography, and distributed among his friends. This work was highly praised by Ruskin, though he unfavourably criticised the drawings in the fifth "Decade." The writer possesses a set of this work, given him by the artist, which comprises examples of the stonemason's art at Senlis, Noyon, Amiens, Laon, Coucy, Soissons, Beauvais, Provins, Troyes, and Chartres. It has a special interest now, as several of these places are within the area of destruction. After his retirement from the Service in 1890, Oliver successfully devoted his leisure to gardening and painting in oil.

Our botanist had hobbies, and he began collecting examples of the illustrated works of the "old masters" in botanical literature at a period when *editiones principes* were to be had at moderate prices, and his collection comprised choice copies of the most celebrated authors. In this matter he may have been influenced by William Arnold Bromfield's legacy to Kew, which included a small but critical selection of herbals.

Oliver's activity was by no means confined to that which bears his name.

He was consulted by Bentham and the Hookers on all knotty points which arose in connection with the compilation of the great 'Genera Plantarum' and other Kew publications. No botanist possessed a more profound knowledge of the classification and geographical distribution of the phanerogamic elements in the vegetation of all regions of the earth; none was better versed than he in the structure of the "formæ abnormes" and "genera anomala," yet he was too conservative and too modest, or perhaps too faithful to the Kew traditions, to give the world his own ideas of an amended classification. Perhaps this was due to the fact that his soul was more enchanted by the beautiful forms of nature than by their arbitrary groupments for purposes of study. His love of the beautiful was exemplified by his matutinal button-hole of flowers, regularly transferred to a little vase on his work table. As a worker he was very rapid; all his actions were nervously performed, yet controlled by an equally spontaneous thinking power. Still, it must be admitted that his scattered descriptions of interesting novelties are sometimes neither so full nor so instructive as he could have made them.

By nature, Oliver was hostile to personal honours in the form of medals and other emblems for distinguished services which he regarded as duties to God and man. Yet he had perforce to receive a Fellowship of the Royal Society in 1863, a "Royal" Medal (1884), and the Linnean Gold Medal (1893). When he retired from the public service in 1890, H.M. First Commissioner of Works placed on record the high appreciation of the Government of the valuable services rendered by Oliver to the Royal Botanic Gardens, Kew, and the distinguished ability which he had brought to bear on the work of his department. In 1891 the University of Aberdeen conferred upon him the honorary degree of LL.D. A portrait of Oliver by J. Wilson Forster was presented to the Kew Herbarium by his friends and admirers in 1893.

In July, 1916, there were four successive keepers of the Kew Herbarium and Library living, and they were photographed in a group in Mr. J. G. Baker's garden at Kew. They were: Daniel Oliver, in his 87th year; John Gilbert Baker, 84th year; William Botting Hemsley, 73rd year; and Otto Stapf, 59th year. The association in a picture of four successive living holders of the same office is such an unusual event that it seems of sufficient interest to be put on record here.

The foregoing lines inadequately commemorate the life of an esteemed friend, a generous colleague, a faithful public servant, and an accomplished man; but they are the words of a grateful pupil and admirer.

The portrait by Maull and Fox was taken in 1903.

W. B. H.

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## CAPTAIN GEOFFREY WATKINS SMITH.

By the death in action on July 10, 1916, of Captain Geoffrey W. Smith we have lost one of the most brilliant of the younger generation of zoologists. He was born in 1881, the youngest son of the well-known Westminster magistrate, Mr. Horace Smith, and Mrs. Smith, of Ivy Bank, Beckenham. Starting his school career at Temple Grove School, he went to Winchester College, and afterwards to New College, Oxford, where he was given a scholarship in 1900. After taking his degree in Zoology, he devoted himself to research and to teaching both in his College and in the Department of Comparative Anatomy in the University Museum. In 1907 he was elected Fellow and Lecturer of New College, and some years later became Tutor. When the war broke out he volunteered his services, joined the O.T.C., and soon obtained a commission in the Rifle Brigade. He was killed by a shell in a trench just captured from the Germans, near Pozières, in France.

Geoffrey Watkins Smith will be deeply regretted by all who knew him. His was a particularly charming personality, a rare combination of simplicity and youthful gaiety, with a refined and truly cultured mind; "one of those bright and joyous spirits whose presence seems to shed happiness." Of a most lovable character, of unfailing good humour and courtesy, he endeared himself to all those with whom he came in contact. His pupils and colleagues in Oxford were no less devoted to him than the men he led at the Front. Geoffrey Smith was a man of wide interests and keen appreciations, yet his learning sat lightly on him. He was no recluse, and thoroughly enjoyed the good things of life. Fond of all kinds of sport, he excelled especially in golf and lawn-tennis, where his elegant figure and graceful movements showed to the best advantage. He delighted in good literature, whether English or foreign, prose or poetry, and himself was the author of a little volume of charming Christmas carols and of other poems, having, doubtless, inherited his literary gifts through his father. Indeed, the excellent style of his scientific writings adds much to their value.

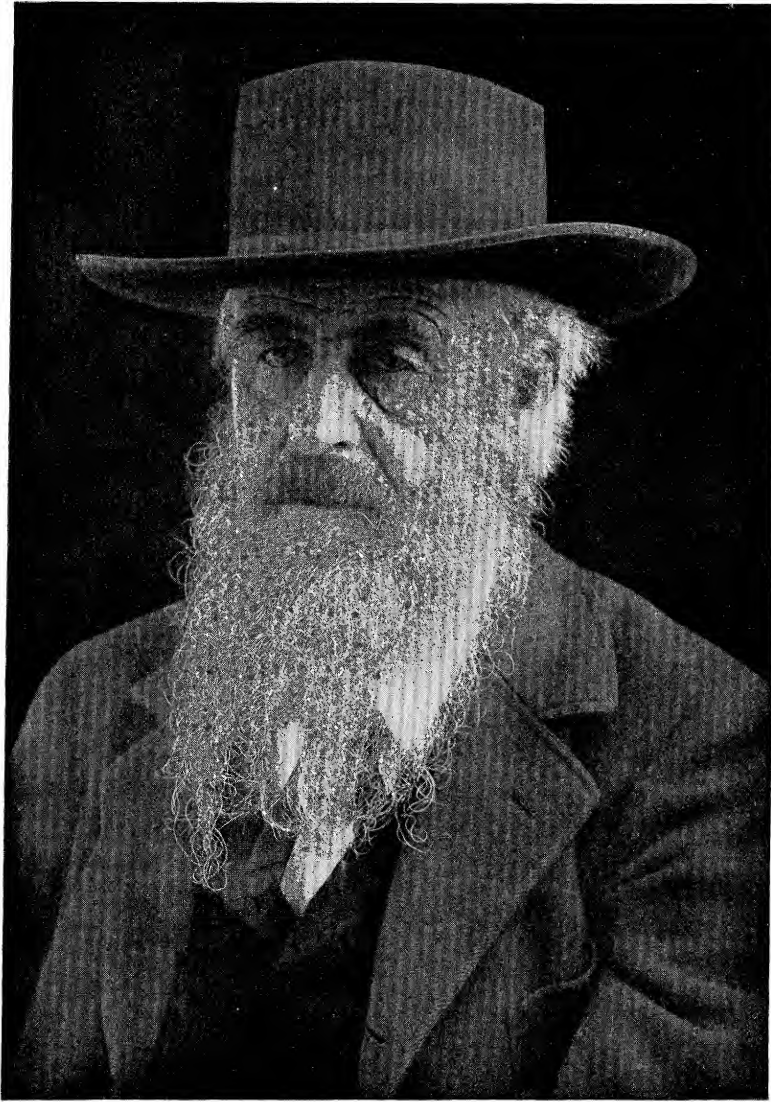
Geoffrey Smith early became interested in natural history, and as a mere schoolboy contributed notes on birds to the 'Zoologist' (1898). Before taking his degree he paid a short visit to Prof. R. Hertwig's laboratory in Munich, where he completed some work on "The Mass Relations of Nucleus and Cytoplasm in *Actinosphaerium*" ('*Biometrika*,' vol. 2, 1903). Although his next paper was an embryological study "On the Development of the *Columella Auris* in Birds" ('*Quart. Journ. Micr. Sci.*,' 1904), he soon became absorbed in the study of the wider problems of heredity and evolution he met in his investigations on sex and parasitism. Having completed his course at Oxford and obtained the University Scholarship at Naples, he went out to Italy in 1903, and devoted his attention more especially to the

Crustacea. In a short paper "On the Metamorphosis of Gnathia" ('*Mitth. Zool. St. Neapel*, 1904), he corrected and completed our knowledge of the life-history of this strange parasite, and shortly after he described among male Tanaidæ and other Crustacea a form of high and low dimorphism comparable to that already known among insects. At the request of Prof. Dohrn he then undertook to write a monograph on the Rhizocephala, a group of parasitic Cirripedes of extreme interest. For this purpose he remained for nearly three years in Naples, and produced a monograph which, although one of the shortest, is certainly one of the most interesting of the whole series. Indeed, it is typical of the scientific work of Geoffrey Smith, who aimed neither at encyclopædic completeness nor at the accumulation of meaningless detail. Bringing to bear on the problems before him a mind of remarkable freshness and originality, he attacked them from new points of view and with the help of new methods, never losing sight of the main points at issue.

Since this monograph, together with a series of "Studies in the Experimental Analysis of Sex," published later in the '*Quart. Journ. Micro.Science*,' 1910-14, formed his most important contribution to science, they deserve special notice. The life-history of the interesting Rhizocephalan Sacculina, a parasite which infects crabs, had already been worked out, chiefly by Delage, and Geoffrey Smith was able not only to confirm the brilliant work of the French zoologist, but also to complete his observations, especially with regard to stages between the larva which has just penetrated into the host at any point, and the young Sacculina fixed in its definitive position on the intestine of the crab. Some time previously Giard had described the remarkable effect produced on the host by the Sacculina, and named it parasitic castration. It results in the profound modification of the sexual characters of the crab, the degeneration of its testis or ovary, and the acquisition by the male of the secondary sexual characters of the female. The difficult problem of the feminisation of the male Smith attacked with conspicuous success. He showed that the female, if parasitised young, was merely made to acquire prematurely the characters of the mature adult; that the male only has the capacity to acquire the characters of the opposite sex, that a male individual, having got rid of the Sacculina, and recovered from its attack, regenerates an hermaphrodite gonad with ova and spermatozoa. This modification of the sexual characters, he argued, is related to a deep-seated change in the general metabolism. In the maturing female fat metabolism is very active for the purpose of nourishing the eggs, the blood becomes loaded with fat and the liver stored with it. The parasite, absorbing food-material, plays the same part in the host as the ripening ovary, stimulates fat production, and thus converts the metabolism of the male to the female type of metabolism. Since the secondary sexual characters appear before the regeneration of the gonad, it follows that in this and in many other cases the development or modification of the characters is due, not to the secretion by the ovary or testis of some special hormone, but to a profound alteration in the metabolism of the animal.

In fact, from these researches and experiments made on birds and frogs, Geoffrey Smith became convinced that the existence of a "reproductive hormone" was unproved. Very ingeniously he reconciled the fact that among the Crustacea the male only shows signs of hermaphroditism with a Mendelian scheme of heredity by suggesting that the female is a homozygote, and the male a heterozygote in respect of sex factors. Smith seems to have been the first to formulate such a theory, and it is interesting to note that it is along these lines that the most successful work on the Mendelian interpretation of sex has since developed. He conceived that it is by the co-operation of these factors of heredity with certain products of metabolism that sexual characters develop, the presence of both being necessary. Other interesting conclusions followed from his work on the Rhizocephala. For instance, he was led to the view that sessile and parasitic Crustacea are often hermaphrodite because of the change in their metabolism due to their peculiar mode of life, that such hermaphrodites have all been derived from the male sex, the female having been suppressed, and, further, that the so-called complementary males of Cirripedes, described by Darwin, are in reality arrested protandric hermaphrodites of the same nature as the large individuals on which they become fixed.

In 1907 he undertook a journey to Tasmania, chiefly with the object of studying Anaspides, a strange fresh-water Crustacean recently discovered there. On this expedition, of which he gave a delightful account in a little book entitled "A Naturalist in Tasmania," he not only obtained Anaspides, but also a related but quite new genus Paranaspides. With the help of this material he was able to bring forward convincing evidence of the correctness of Dr. Calman's contention that the Anaspidacea are the remnant of a once widely distributed group found in Carboniferous strata, and worthy of being placed in a separate division, the Syncarida. He also collected other forms on his travels, and published monographs on the land and fresh water crayfishes of Australia, in which the geographical distribution, habits, and inter-relationships of the species are discussed with his usual skill and originality ('Proc. Zool. Soc.,' 1912 and 1913). Further, we owe to Smith the excellent account of the Crustacea in the 'Cambridge Natural History' (1909). Quite recently have appeared a paper on "The Genus Lernæodiscus" ('Journ. Linn. Soc.,' 1915) and a continuation of some work begun with G. H. Grosvenor, on the reproduction of water fleas ('Proc. Roy. Soc.,' 1915). The appearance of sexual forms in the life-cycle of these Cladocera reproducing parthenogenetically is here shown to be not necessarily rhythmical and entirely due to internal causes as Weismann supposed, but capable of being suppressed or encouraged by external conditions, and subject to experimental control. Evidence is also brought forward that rapid growth and parthenogenesis are related to glycogen storage, while sexual reproduction is related to fat storage, differences in metabolism being at the root of the antagonism between growth and sex. Other problems are dealt with in the "Studies," such as the parasitism of bees by the insect Stylops, and the



*Alfred Foster Laubach*

sterility of hybrid birds due to abnormal spermatogenesis and the development of giant spermatozoa.

Smith seems to have possessed "the gift of penetrating the secrets of Nature." As in play so in work, he never wasted time or strength. Preferring the simplest methods, he worked rapidly and reached his conclusions quickly. Yet when needful no one was more careful to scrutinise results and test them with the use of the best technique and most scrupulous impartiality.

Several of his works were written in collaboration with others, for he was an excellent teacher, and always most successful in inspiring his friends and pupils with some of the enthusiasm he felt so keenly himself.

E. S. G.

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#### HERMANN GRAF ZU SOLMS-LAUBACH, 1842-1915.

HERMANN GRAF ZU SOLMS-LAUBACH was born on December 23, 1842, at Laubach, in Upper Hesse, the seat of his branch of the ancient family of Solms, which traces its descent to Marquard, Graf zu Solms im Oberen Lahngau, in 1129. His parents were Graf Otto zu Solms and the Gräfin Luitgard, Princess of Wied.\*

On leaving school, Solms wished to pursue a learned career, but his father objected, not, as has sometimes been said, on family grounds, but because he did not consider his son sufficiently gifted. It appears that he had not done uniformly well at school. However, he was eventually allowed to enter at the University of Giessen; at that time he was still in doubt whether to take up History or Natural Science. It was Leuckart's lectures on Comparative Anatomy which attracted him to the latter. That he ultimately followed Botany rather than Zoology was due to his early surroundings, for both his uncle and his eldest brother were botanists, and Solms' interest in the subject began when he was still a boy.

After one term he left Giessen for Berlin, where he attended Alexander Braun's lectures on Botany. He afterwards spent a term with de Bary at Freiburg (the beginning of an association which influenced his whole life), but it was at Berlin that he took his Degree in 1865. His dissertation was on a parasitic plant, the Toothwort (*de Lathrææ generis positione systematica*), a line of work which occupied him much in later years.

\* For many details of Solms' life the writer is indebted to the obituary notice by his successor, Prof. Jost, in 'Berichte der Deutschen Botanischen Gesellschaft,' vol. 33, pp. 95-112 (1916).

After a visit to Geneva, to study the famous collections there, he made a scientific journey to South Portugal, where he specially interested himself in the distribution of mosses. He then returned to work with de Bary, following him on his removal to Halle, where Solms became *Privatdozent* in 1868.

As regards Solms' part in the war of 1870, Dr. Lotsy, an old pupil of his, writes: "As far as I am aware . . ., he served as a *Johanniter*, viz., as one whose sole duty is taking care of the wounded."

In 1872 Solms became *Professor Extraordinarius* at the new German University of Strasburg. He remained there, as a colleague of de Bary's, till 1879, when he was appointed full Professor at Göttingen, succeeding Griesbach. In 1883 he visited the Tropics, working, at Treub's invitation, in the new laboratory at Buitenzorg.

At the close of 1887 Solms was invited to occupy the Chair of Botany at Berlin, as successor to Eichler. After much hesitation he accepted the call, but the death of de Bary in January, 1888, caused him to reconsider his decision; he preferred in the end to succeed his old friend and teacher, and became Professor and Director of the Botanic Garden at Strasburg. He continued to hold this post for 20 years, and, after his retirement, remained at Strasburg till his death. He passed away peacefully on November 24, 1915, his mental powers, in spite of much bodily weakness, retaining their activity almost to the last.

Solms-Laubach's original work as a botanist covers a remarkably wide area. He began as a collector of plants in the field, and retained his love for botanical excursions all through life. Prof. Jost quotes an amusing passage from a letter from Alexander Braun to de Bary, introducing Solms: "Wenn Du ihm das verdamnte Exkursionenmachen abgewöhnen kannst, wird vielleicht etwas ganz brauchbares aus ihm." As a matter of fact, the excursion habit made him a sound systematist, gave him his keen interest in the geography of plants, and laid the foundation of his greatness as an investigator.

One side of his work throughout life was purely systematic; he monographed a number of families for de Candolle, Engler, and other editors. Among these families several (*Rafflesiaceæ*, *Hydnoraceæ*, *Lennoaceæ*) are parasitic Phanerogams, a biological group of extraordinary interest, on which Solms was probably the leading authority. His earliest (1863), and almost his latest work (1914), was on parasitic plants, and to his elaborate anatomical and morphological researches a great part of the existing knowledge of these strangely modified forms is due.

Other systematic publications stood in close relation with Solms' work on the history of cultivated plants, another favourite subject of his. The Figs, the Papaw, Wheat, Tulips, and Strawberries were all investigated by him; the connection of cultivation with History and Philology, studies in which he never lost his interest, was a special attraction to him. His attention was not much directed to the Genetics of cultivated plants, which would now

seem the most promising line of research, although we are informed by Jost that Solms knew Mendel's work well, long before its rediscovery in 1900.

In other connections, however, Solms showed a keen interest in the question of the origin of species. His studies on Cruciferae, for example, started with the description of *Capsella Helgeri* (1900), a form with indehiscent fruits, which, on the ground of cultural experiments, he regarded as a mutant of the common *C. Bursa-pastoris*.

His interesting and original treatise on the geography of plants (1905) opens with a discussion of the origin of new forms, in which he shows himself much influenced by the views of Nägeli, a writer whose theories on the subject have never much appealed to evolutionists in this country. The latter part of the book, dealing directly with distribution, and based largely on his own observations in the field, is of much higher value.

In addition to the work on parasites already mentioned, Solms carried out a number of morphological researches extending to all classes of plants. Among Fungi, he published on *Empusa* (1869), *Penicillioopsis* and *Ustilago* (1886), but his works on Algæ are of far greater importance. Quite early, in 1867, he elucidated the reproduction of *Batrachospermum*, and founded the genus *Janczewskia*, for some very remarkable epiphytic Florideans. In his monograph of the Corallineæ of the Gulf of Naples (1881), he cleared up the complicated reproductive processes in this important family. At a later date he extended his researches to calcareous Algæ of widely different affinities (Siphonæ), publishing in 1892 a paper on the genera *Cymopolia*, *Neomeris*, and *Bornetella*, while in 1895 the Linnean Society of London had the honour of bringing out his monograph of the Acetabulariæ, a most important work, dealing with fossil as well as recent forms, and the only memoir of his published in this country, and in English.

Among the Bryophyta, he wrote on some of the less known families of Marchantiaceæ (1897 and 1899), and, of recent vascular Cryptogams, he investigated *Psilotum* (1884), especially its propagation by gemmæ, and, in later years, the branching of *Isoetes* (1902). His paper on the morphological construction of *Stangeria* and other Cycads (1890) is well known, and of equal importance for recent and fossil botany. Of his morphological researches on Angiosperms, that on monocotyledonous embryos with an apical growing point (1878) is of quite special interest.

Physiology he scarcely touched on, unless we put under this head observations on the occurrence of calcium oxalate in the cell-wall (1871).

We now come to Solms' work in Fossil Botany, the field in which he undoubtedly exercised the strongest influence. Some interesting remarks by Prof. Nathorst on Solms' position as a palæobotanist are quoted in Prof. Jost's obituary notice. Prof. Nathorst points out that the leading idea in all Solms' work on the subject is that fossil, like recent plants, have to be considered from a purely botanical point of view. Previous writers, to use Solms' own expression, "had to serve two masters, Palæontology and Botany." In Solms' handbook the botanical results are treated independently,

and for the first time made accessible to botanists in a connected form. The significance of palæobotany from a developmental and systematic point of view thus became self-evident. Solms conceived the object of his work to be the completion, from fossil data, of the Natural System of Plants.

The 'Einleitung in die Palæophytologie,' published in 1887, and translated into English four years later, under the title 'Introduction to Fossil Botany,' certainly made a great impression on botanists, and to many was the beginning of their interest in the fossil record. The present writer was among these, and well remembers how the reading of Solms' book, on its first publication, revealed to him, what he had never quite realised before, that fossil plants really matter to a botanist. It prepared him to take an intelligent interest, at a later date, in the things themselves. The book owed its influence entirely to its solid merits as a botanical exposition of the fossil evidence. It is inadequately illustrated (though the figures are well chosen) and Solms' style was seldom attractive.

The 'Einleitung' appeared early in Solms' career as a palæobotanist, at a time when he had published little original work on the subject.\* Hence it may seem to the present-day reader to err on the side of over-caution. For example, the Calamariæ, though he strongly inclined to Williamson's view of their affinities, are widely separated from the Equisetacæ, the whole of the Lycopod series intervening.

The important palæobotanical researches which followed up the publication of this book were in many cases the outcome of preliminary work done in the course of its preparation. The book may be said to have built its own tomb, for owing to the mass of new work to which it gave the stimulus, it soon became out of date, and Solms could never be induced to consider a second edition. Its historical interest as a classic will always remain.

Solms' special work in Fossil Botany must be dealt with very briefly, though it merits a full review. Much the greater part is on remains showing structure; in the early and admirable memoir on Permian Coniferæ (1884), great stress is already laid on anatomical data.

Solms' book contains an excellent account of *Bennettites*, in which he had already recognised the embryo. This was followed up, in 1890, by the publication of his well-known paper on the fructification of *B. Gibsonianus*, completing the work of Carruthers, and clearing up doubtful points. This investigation was on English material, and the paper was accordingly translated in the 'Annals of Botany' for the following year. An important memoir, written in Italian, in collaboration with Capellini, on the Italian specimens of Bennettitæ, was published in 1892. It was here that Solms first found evidence of the bisexual character of the Bennettitæan fructification, foreshadowing the brilliant discoveries of Wieland.

In the same year Solms began a series of papers on the Lower Carboni-

\* In the introduction to his paper on Permian Coniferæ (1884) Solms speaks of himself as "Homo novus" in the field of Palæophytology.

ferous plants of Falkenberg in Silesia (1892-1910). The first part deals chiefly with *Zygopteris* and *Lepidodendron*, in which he found the ligule, discovered just before in another species, by Hovelacque. Part II (1893) is devoted to the isolated type *Protopitys* (Cycadofilices), of which he first elucidated the structure. The third part, 1897, gives a full account of the anatomy of *Archæocalamites*; while the fourth (1910), appearing after a long interval, is perhaps the most important of all, describing those remarkable polystelic Cycadofilices, *Völkelia*, *Cladoxylon Kidstoni*, and *Steloxylon*.

In the meantime Solms published another paper, of great importance, on plants of a similar horizon, namely, Unger's specimens from Saalfeld (1896). Our knowledge of the genera *Cladoxylon* and *Calamopitys*, besides many other forms, is to a great extent based on this work, to which the present writer is especially indebted.

In 1894 he described the structure of *Stigmariopsis*, perhaps representing, as he suggested, the underground organs of the smooth-barked Sigillarias.

The memoir on Middle Devonian plant remains from the Lower Rhine (1895) is of interest from the age of the fossils. The specimens were, however, fragmentary. It is worth noting that Solms at that time recognised Dawson's *Psilophyton princeps* as a distinct and important type, though sceptical as to its supposed fructification. It is only within the last year that the work of Halle and of Kidston and Lang has established the group Psilophytales on a firm basis and justified Dawson's conclusions.

In the same year Solms gave an admirable account of a new type of *Sphenophyllum* cone, under the name *Bowmanites Römeri*, and added much to our knowledge of the family.

The work on *Medullosa Leuckarti* (1897) is a valuable contribution to the anatomy of one of the most remarkable groups of Palæozoic plants. The existence of a class of plants, including *Medullosa*, intermediate between Ferns and Cycads, suggested by Williamson, was first recognised by Solms, as far back as 1887.

In 1899, besides a work with Steinmann on the Rhaetic Flora of Chili, Solms published an account of the Triassic genus *Pleuromeia*, probably a late representative of *Sigillaria*.

His work on the petrified plants of Franz Josef's Land, in the Arctic regions (1904), though the fossils were botanically of no great interest, enabled him to determine the age of the Flora as approximately that of the Wealden.

Of his later fossil works, the chief is a paper with the singular title "The Deep Black *Psaronius Haidingeri*, of Manebach, in Thuringia" (1911). In this he explained for the first time the true nature of the zone enclosing the adventitious roots of *Psaronius*, and showed that it is not part of the cortex, as was generally supposed, but a dense felt of hairs, springing partly from the stem, partly from the roots themselves. He thus confirmed an opinion expressed some years before by Farmer and T. G. Hill.

Solms' last fossil paper was on "*Tietea singularis*, a New Fossil

Pteridineous Stem from Brazil" (1913). He compared the specimen with *Psaronius*, but there seems to be some doubt whether he rightly interpreted its structure.

Two lectures by Solms may be mentioned here, both given before a Strasburg Society. The first (1906) was on the Significance of Palæophytology for Systematic Botany. He points out, with admirable clearness, the bearing of fossil evidence on evolution, especially as confirming the great morphological discoveries of Hofmeister. He dwells in particular on the connection between Ferns and Cycads, and on the geological history of the main groups of Ferns. The other lecture was given at a celebration in 1909 of the 100th anniversary of Darwin's birth. While Solms speaks with warmth and just appreciation of Darwin himself, he summarily dismisses the theory of Natural Selection, saying, "To-day it is doubtless wholly given up by almost all botanists and by many zoologists." Thus Solms, like Zeiller, was an Evolutionist, but by no means a Darwinian. In his depreciatory estimate of Darwin's great theory, the influence of Nägeli can be clearly traced. But it is true that the Darwinian period was beginning to wane by the time that the celebrations were held.

All Solms' original work was sound and accurate in the highest degree, and it covered probably a wider field than that of any contemporary botanist. His memoirs, however, are by no means easy reading; the style is dry, and it is sometimes difficult to extract the important results from the mass of detail. He was personally an infinitely more interesting man than one would imagine from reading his special works.

His real character comes out better in his reviews, which are often trenchant and piquant. It is quite worth while to look through them in the pages of the 'Botanische Zeitung' and 'Zeitschrift für Botanik,' which he edited for so many years.

As a teacher Solms must have been impressive and stimulating. The writer once had the good fortune to hear one of his elementary lectures at Strasburg; the subject was Phyllotaxis and Branching. His manner of lecturing was striking and somewhat eccentric; all the time he was pacing up and down like a caged lion, and making free use of his arms, in a way that all his friends will recall. The lecture was clear and vigorous; he took great pains with the elementary course.

Dr. Lotsy writes: "I think I can state with justice that I never have had a better teacher than him, in the years I spent at Göttingen. Solms had very curious peculiarities in lecturing; it even happened that in his enthusiasm the lamps above his catheder came down, but he knew how to rivet our attention to such a degree that such things were hardly noticed by us."

In the laboratory Solms' great principle was to let his pupils work out everything for themselves. He complained of English students for not being independent enough in their work.

In private life Solms was a delightful companion, always interesting and

amusing, and with a wealth of knowledge of all kinds rarely equalled. He was a great traveller and endowed with a wonderful memory, so that he was full of intimate reminiscences of many lands. Jost tells us how a Russian friend said of him, "He knows Moscow better than I do." The writer can say the same of Solms' knowledge of this country. He was often in England, where his tall figure and striking features were familiar at many scientific meetings; on his first visit, in the sixties, he was a guest of Sir William Hooker's at Kew. His English was fluent, but original. Some of his best friends were Englishmen; in particular he was much attached to the late Prof. W. C. Williamson, whose work he was the first to appreciate. To those whom he found congenial—and he was not hard to please—Solms was an absolutely true and faithful friend, generous and open-hearted.

When in England he took a great interest in the country and its Natural History, as well as in the people. He was much impressed by the wild box trees on Box Hill, and when in Hampshire a few years ago showed great pleasure at seeing bluebells (*Scilla nutans*) wild for the first time in his life.

Solms received various marks of recognition in this country; he was elected a Foreign Member of the Royal Society in 1902, and received a similar honour from the Linnean Society in 1887, the Royal Microscopical Society in 1895, and the Geological Society in 1906. The Honorary Degree of Sc.D. was conferred upon him by the University of Cambridge at the Darwin Celebration in 1909. He was awarded the Gold Medal of the Linnean Society in 1911, coming over in person to receive it, an occasion on which he made a graceful speech in returning thanks.

Solms was so well known and appreciated in this country, and had such a friendly feeling for us, that the declaration of war must have been a great blow to him. Jost, after speaking of Solms' many friends in England, adds, "Um so grösser war im August, 1914, sein Schmerz, als er sehen musste, dass auch solche Freunde dem deutschen Volk den Krieg erklärten,"—rather a pathetic expression of the German point of view.

Dr. Jongmans informs us that while Solms did not agree with the "stupidities" of certain German extremists, he was much annoyed at some English war publications depreciating German science and asserting the impossibility of future scientific collaboration. He was convinced that science must always be international. Dr. Lotsy writes: "He certainly was a good German, but in the best sense of the word."

Finally, the writer is permitted to quote a letter from Miss G. Lister, F.L.S., with which this notice may appropriately conclude: "I felt a great personality had passed away when I saw a few days ago in 'Nature' that Count Solms was dead. . . . How well I remember his kindly behaviour towards us when my father and I came to Strasburg to look through De Bary's *Myxos*—the fine room we were given to work in, and his daily visits to see how we were getting on—always with a cigarette in his fingers, and the request 'Is it permitted?' before he smoked, and his planning a little

excursion for us to the Black Forest to see the 'young green' of the beeches. Then the delightful visit he paid us at Higheliff—all past and gone! The blessed thing is to think the friendship can never be disturbed now, and the memory of his noble life remains."

Besides those names already mentioned, the writer is indebted to Prof. W. G. Farlow, Prof. A. G. Nathorst, and Prof. F. E. Weiss, F.R.S., for information and help.

D. H. S.

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ROBERT BELL, 1841–1917.

Dr. ROBERT BELL died on June 18, 1917, at Rathwell, Manitoba, in the 77th year of his age. He was born in Toronto on June 3, 1841, and was a son of the Reverend Andrew Bell, of the Free Church of Scotland. He was educated at the Grammar School of the county of Prescott, Ontario, and subsequently at McGill University and the University of Edinburgh.

While still a boy of 15 years of age he joined the Geological Survey of Canada, under Sir William Logan, in the capacity of Junior Assistant, and was rapidly promoted in the service, where he remained—with but one short interval—for over fifty years, retiring as Chief Geologist and Acting Director in the year 1908.

He married Agnes, daughter of the late Alexander Smith, of Westbourne, Glasgow, and Auchentroig, Stirlingshire, and leaves one son and three daughters.

Practically nothing was known of the geology of Canada, and very little with reference to its geography, when Mr. William E. (afterwards Sir William) Logan was called upon to undertake the organisation of the Geological Survey of Canada, and, as its first Director, to carry out the mapping of this vast area and the examination of its mineral resources. Dr. Bell's work, as a member of Sir William Logan's staff, in these early years consisted therefore exclusively of geological reconnaissance and geographical exploration. Even in later years, and until his administrative work confined him to his office, Dr. Bell's work remained essentially of this character.

The exploratory traverses and track surveys which he carried out were chiefly within the area of the great Laurentian protaxis or "Canadian Shield," which forms such a striking feature, and which has played, and will continue to play, so important a rôle in shaping Canadian history and in influencing the character of the Canadian people. Dr. Bell's lines of exploration crossed and re-crossed this area from the Atlantic Coast to the Great Lakes on its western border, and from Lake Huron and Lake Superior on the south to the Arctic Sea, following the waterways of this great land. He also

worked along the coast-line when acting as Geologist and Naturalist to the "Neptune" Expedition in 1884, and to the "Alert" Expedition in 1885, both of which carried out explorations in Hudson Bay and Hudson Straits; also on the "Diana" Expedition in 1897, when he surveyed the coast of Baffin Land, and was one of the first white men who penetrated to the great lakes in the interior of that immense island. Probably no man has ever traversed this great pre-Cambrian area so completely as did Dr. Bell.

The results of his work were published chiefly in the 'Annual Reports of the Geological Survey of Canada,' but he also contributed papers—some 200 in number—to leading scientific and technical journals in Great Britain, Canada, and the United States.

Dr. Bell's work on the Geological Survey of Canada was interrupted from 1863 to 1867. During these years he occupied the Chair of Chemistry and Natural Science in Queen's University, Kingston, Ontario, which Chair he resigned at the end of this period to resume his work on the staff of the Geological Survey. He was not only a geologist, but had also a good general knowledge of natural history, and his reports contain much information concerning the flora and fauna of the remote regions in which he worked. His travels in these wild northern lands also brought him into intimate relations and association with the Indians, who, with the exception of the employees of the Hudson Bay Company, were at that time their only inhabitants. His expeditions were carried out almost entirely in birch-bark canoes, with Indians or half-breeds as his guides and voyageurs. He thus acquired an extensive knowledge of Indian folk-lore and legendary story, and was so honoured and esteemed by the red-men that he was elected as a chief by the Algonquin Indians of Grand Lake.

In two papers read before the British Association for the Advancement of Science in 1881 and 1909 respectively, and also in a pamphlet entitled 'A New Route to Europe from the Interior of British North America,' published in Montreal in 1881, he advocated strongly the development of the Hudson Bay route, to which since that time so much attention has been directed.

Dr. Bell was the recipient of many academic degrees, and many honours were conferred upon him by learned societies. He received the degrees of D.Sc. (Cantab. and McGill), M.D., C.M. (McGill), LL.D. (Queen's). He was elected into the Royal Society in 1897. He received the Imperial Service Order in 1903. He was one of the Foundation Members of the Royal Society of Canada, and a Fellow of the Geological Society of London and of the sister Society in America, as well as of many other learned bodies. He was a member of the Geographical Board of the Dominion of Canada.

Dr. Bell was awarded the King's or Patron's Gold Medal of the Royal Geographical Society in 1906, and the Cullum Gold Medal of the American Geographical Society in the same year. His name will always be associated with the early exploration and the development of the Dominion of Canada.

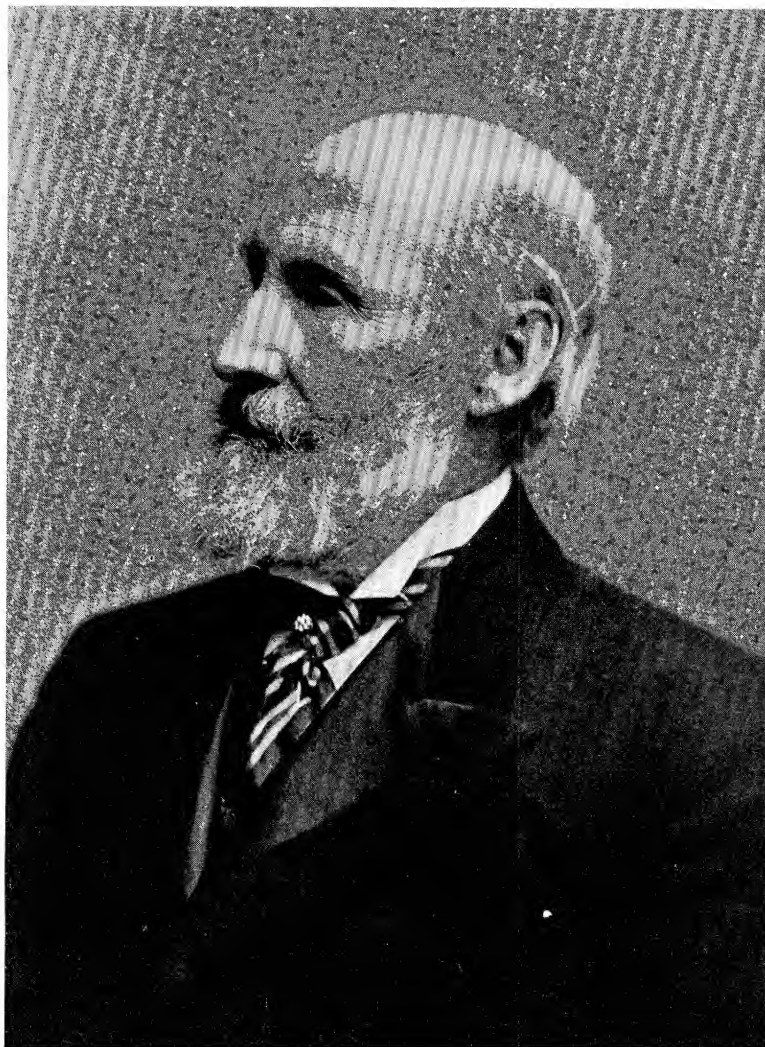
F. D. A.

## EDWARD HULL, 1829-1917.

THE pursuit of geology seems eminently calculated to prolong life, doubtless due to the healthy open-air existence which its study involves. Many names of distinguished geologists who have passed away might be mentioned in support of this view, and now we have to add to the list that of Prof. Hull, who survived to his 89th year, having maintained his usual health and vigour to within a month of his death. He was the eldest son of the Rev. J. D. Hull, curate in charge of the parish of Antrim, where he was born on May 21, 1829. At the age of 12 he was sent to the School for the Sons of the Irish Clergy, then at Edgeworthstown, in County Longford. His life there was not happy, but after the transference of the school in 1843 to Lucan, near Dublin, and the appointment of a new headmaster, he appears to have enjoyed school life. It was his father's wish that he should become a clergyman of the Church of Ireland. With this object in view, he joined a class of students of the Irish language, conducted by the Professor of Irish of Trinity College, and gained a prize in this subject given by the University. About the same time a course of experimental lectures on hydrostatics, mechanics, and allied subjects, given at the school by a Dublin doctor, aroused his interest in natural science, and the idea of entering the Church was given up. Owing to the recent rise and progress of railway construction all over the country, there were, at that time, many openings for civil engineers, and it was therefore decided that he should be trained for that profession. He accordingly entered Trinity College, and at the end of four years not only obtained a diploma for civil engineering, but also graduated in Arts.

Among the subjects taught during the engineering course was that of geology. This brought him in contact with Prof. Oldham, F.R.S., Director of the Geological Survey of Ireland, whose lectures were delivered with such lucidity and attractiveness that, to use Hull's own words, "I found geology to be the subject that of all others captivated my mind." Failing to obtain immediate employment as a civil engineer, he was introduced by Oldham to Sir Henry de la Beche, who was then Director of the Geological Survey of Great Britain. His application for employment on the Survey, supported by Sir Roderick Murchison, with whom his family was distantly connected, was granted, and so, once again, his plans for a career were changed, for the third and last time.

Hull began work on the Geological Survey in Wales under Beete-Jukes, afterwards Professor, in 1850, and during the succeeding years took part in the mapping of a tract of country in the west of England, chiefly on Jurassic rocks. The results of this early work are recorded on the maps of the Geological Survey and in four descriptive "sheet-memoirs," of which he was either author or part author, published between 1851 and 1861. One of these



*Edward Hull*

memoirs, that on the 'Geology around Cheltenham,' illustrated with maps and sections and a plate of fossils by C. R. Bone, deserves special mention as an excellent example of combined geological and palæontological work. More money was expended upon these earlier memoirs of the Survey than on those of later date, which were too often treated very parsimoniously by the authorities.

Subsequently, Hull surveyed a large portion of the Lancashire coal-field with bordering areas, and this ground was described between 1860 and 1866 in five sheet memoirs from his own pen, with a sixth written in collaboration with the late Prof. A. H. Green. He also produced in 1869 a district memoir on the Triassic and Permian rocks of the Midland Counties, which remains the only general account of these rocks that has so far been published.

During the 17 years of his work in England and Wales much time was devoted to the coal-fields of Lancashire, Cheshire, and North Wales, and the knowledge thus acquired led him in 1861 to publish his first separate work on the coal-fields of Great Britain; a treatise dealing not only with their structure but also with the probable quantity of coal, both in the known coal-fields and beyond their visible limits, to a depth of 4000 feet from the surface.

Soon after the publication of this book, the great question of the duration of our coal supplies attracted public attention, and this has led to a second, third, fourth, and even fifth, edition; a striking proof of the need as well as the value and importance of this work of reference both geologically and commercially.

As a further result of his work on the Survey in England, Hull wrote several suggestive papers, including one of special interest, "On Isodiametric Lines as a Means of representing Sedimentary Clay and Sandy Strata, as distinguished from Calcareous Strata, with special reference to the Carboniferous Rocks of Britain" ('Quart. Journ. Geol. Soc.,' vol. 18, 1862). In it he points out that, where mechanical and organic sediments are associated in any formation, one group increases in thickness as the other diminishes. In order to illustrate this point he gives a map of Great Britain on which the thicknesses of the two groups of sediments in the Carboniferous rocks are indicated by a series of lines drawn through the places where these thicknesses are known or assumed to have been equal. The map brings out in a most striking manner the contrast, so far as distribution is concerned, between the two types of sediment, and indicates the general directions from which the mechanical sediments were derived. Subsequent research during the past fifty years has not seriously modified the conclusions at which he then arrived.

In 1855 Hull was elected a Fellow of the Geological Society of London, and in 1867 a Fellow of the Royal Society. In this latter year also he was transferred to the Geological Survey of Scotland as District Surveyor. After a short term of two years in Scotland (1867-8) he was appointed Director of the Irish branch of the Survey, a post rendered vacant by the

untimely death of Prof. J. Beete-Jukes. While in Dublin he not only served as Director of the Geological Survey, but also fulfilled the duties of Professor of Geology in the Royal College of Science, an appointment which had been held by Oldham and by Beete-Jukes. The post of Director of the Irish Survey was not without its difficulties, and it stands to Hull's credit that he carried on the labours of his predecessors with such success that by the time of his retirement, in 1891, not only were all the sheets of the 1-inch Geological Map of Ireland published, but each sheet was accompanied by a descriptive memoir. One wishes the same could be said of England and Scotland. Either as sole or part author, Hull's name appears on the title-pages of nine of these memoirs, chiefly relating to the northern part of the island.

In 1871 the first Royal Commission issued their 'Report on the Coal Supply of Great Britain and Ireland,' to which Prof. Hull contributed much valuable information, and, owing to the death of Prof. J. Beete-Jukes, who was one of the Commissioners, he prepared, or edited, the final report on Ireland. Thirty years later a second Royal Coal Commission was appointed, on which Hull served as a member, devoting five years to this important subject, 1901-5. In February, 1890, the Council of the Geological Society awarded the Murchison Medal to him, and in the following year he retired from the Survey, having been in office under four successive Directors General: de la Beche, Murchison, Ramsay, and Geikie, names which will ever be associated with the history of geological science.

But his activity did not cease with his retirement from official work. First as Secretary and later as President of the Victoria Institute, he contributed many papers to their publications. He also contributed to the 'Geographical Journal' and to the 'Geological Magazine,' and published, independently, a large atlas and memoirs dealing with the 'Sub-oceanic Physiography of the North Atlantic Ocean,' a subject in which he became much interested during the later years of his life. The complete list of his published memoirs, books, and papers contains more than 250 entries, many of which relate to other subjects than pure geology.

In 1883, on the recommendation of General Sir Charles Wilson, Hull was appointed as leader of an expedition, despatched by the Committee of the Palestine Exploration Fund, for the purpose of carrying out a topographical and geological survey of portions of Arabia Petræa and Palestine. To the late Lord Kitchener (then Captain), with the assistance of a staff from England and Egypt, was entrusted the topographical work. The expedition travelled from Cairo through the Peninsula of Sinai to the Dead Sea by the Arabah valley, crossing Southern Palestine to Gaza and visiting Jerusalem. In his report he calls attention to the great fracture in the earth's crust extending northwards from the Gulf of Akaba to the Dead Sea and along the valley of the Jordan. The narrative of this most successful expedition was published in 1884 by the Committee of the Palestine Exploration Fund in a work entitled 'Mount Seir, Sinai, and Western Palestine.'



*Keith Lucas.*

Hull's kindly spirit and geniality will long be remembered, especially by those who took part in the friendly gatherings of the Royal Dublin Geological Society and the Irish Microscopical Society. His long career extended from the days of de la Beche, Sedgwick, Murchison, Lyell, and Prestwich through those of Ramsay, Forbes, and Huxley down to the present day, from the youthful period of our science to that of its full grown manhood as we see it now. In all these surroundings of men and of progress, Edward Hull moved and "played his part," and did his best to advance geological knowledge, both in his full period of official life on the Survey and in the later years of his activity as "a geologist at large," always striving to contribute his quota to the "advancement of natural knowledge," for which, as a Fellow of this Society, he was elected 50 years ago.

H. W

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KEITH LUCAS, 1879-1916.

PART I.

KEITH LUCAS was born March 8, 1879, and was killed on October 5, 1916, when he was 37 years old. His death was caused by a collision with another aeroplane in mid-air, when flying over Salisbury Plain, and was instantaneous.

He was the son of Francis Robert Lucas and grandson of Ralph Willett Lucas, a Lieutenant in the Royal Artillery who fought in the Battle of Waterloo. His father, Francis Lucas, went as engineering pupil to the Telegraph Construction and Maintenance Company, East Greenwich, when he was 15 years of age and was one of the young engineers chosen to go out in the S.S. "Great Eastern" when the first Atlantic cable was successfully laid. He afterwards went in her on every voyage. After this he was made manager of the works at Greenwich, but continued to go to sea and lay cables until he had laid the Pacific or "All Red Cable" round the world. He then gave up the work at sea and became Managing Director of the Company. During his life at the works he was continually inventing and improving the machinery for cable manufacture and cable laying. Many of his inventions have been adopted by the Admiralty as well as by cable companies.

Keith Lucas' great-grandfather on his mother's side, Edward Riddle, and his grandfather, John Riddle, were both good mathematicians, both were Fellows of the Royal Astronomical Society, and both had great reputations as

teachers of navigation and nautical astronomy.\* Lucas inherited from his ancestors his scientific interests and ability, his power of designing new apparatus, and his engineering capacity, as well as his great manual dexterity.

From the Rev. T. Oldham's preparatory school at Blackheath, he gained a Classical Scholarship at Rugby in 1893. He was in the Volunteers at Rugby, and in the Shooting Eight for four years; and was captain of it in 1897-8. He was head of the School House before he left to come up to Trinity College, Cambridge, with a Minor Scholarship in Classics.

His interest in Engineering and Science was encouraged at home, where he learnt the use of many tools. His work was from the first neat and practical. His mastery of the design of new instruments, coupled with his capacity of making what he wanted, gave him great power in the art of experiment in such dissimilar sciences as Physiology and Aeronautics.

At Cambridge he devoted himself to Science, and took a First Class in the Natural Sciences Tripos, Part I, 1901. After the Tripos, he felt the strain of doing so much work in a new direction, and at this time his old school friend, Charles Powell, was killed in the Boer War. Lucas felt his death acutely. He gave up working for the second part of the Natural Sciences Tripos and went to New Zealand for the sake of rest and change. There, he measured the depth of some lakes reported as bottomless, and when he returned to England he published the paper, "A Bathymetrical Survey of the Lakes of New Zealand," in the 'Geographical Journal,' May and June, 1904. His father's experience in deep-sea sounding and cable laying was naturally helpful to him. This was the beginning of his original work. The advances he made in Physiology are described in a separate Memoir, and were not interrupted till the war induced him to devote his abilities to Aeronautics.

He was elected a Fellow of Trinity in 1904 and in the same year gained the Walsingham Medal and the Gedge Prize. He was appointed Lecturer in the College in Natural Sciences and took the Degree of D.Sc. in 1911. He was elected a Fellow of the Royal Society in 1913, having already delivered the Croonian Lecture in 1912. He also gave the Page May Memorial Lectures in connection with the Institute of Physiology, University College, London, in 1914.

He felt that all should take their full share in the work connected with the administration of the University and College business. He was on the Council of his College for some years, spoke little, but always to the point, and took his full share in decisions, and his opinion was highly valued. When the new Physiological Laboratory at Cambridge was being planned, and later, before it was occupied, he did much to make the arrangements satisfactory and efficient.

Keith Lucas was keenly interested in and enjoyed his work as a teacher, both in his College classes and in his University lectures and demonstra-

\* 'Dictionary of National Biography' and 'Monthly Notices of the Royal Astronomical Society,' February, 1855; 'Monthly Notices of the Royal Astronomical Society,' February, 1863.

tions. He felt the importance of this work, and, with his knowledge of the difficulties of the subject and his power of clear explanation, it was natural that he should be a most successful teacher. The work he had himself done in Physiology, and his hope for far greater advances, both by his own work and the work of others, inspired in his pupils enthusiasm for further investigations.

In 1909 Keith Lucas married Alys, daughter of the Rev. C. E. Hubbard. He leaves three sons. He became a Director of the Cambridge Scientific Instrument Company in 1906, and only resigned in 1914, when he joined the Royal Aircraft Factory. During this time he designed many instruments both for teaching and research.

Even when he was in New Zealand, and before he had begun his original scientific work at Cambridge, and had so much to do with the design of scientific instruments, he thought that the great flaw in instrument making was that there had to be much perfect and expensive workmanship to make up for faults in design. He agreed with the definition of a well designed instrument as one which worked smoothly and well, and gave accurate results when the rubbing surface became worn or the parts damaged, and even if badly made. In his designs, each moving piece was allowed only the requisite freedom to move in the proper manner, and was guided only at the correct number of points. The importance of these considerations was long ago pointed out by Clerk Maxwell and Lord Kelvin, and generally leads to a good design as defined above.

In his work with the capillary electrometer, he had to analyse a great number of photographic curves; to do this he designed an instrument which saved a great deal of time, and gave results with remarkable accuracy. In connection with this work, he designed a rapid and trustworthy method of drawing fine capillary glass tubes. He also designed a photographic time-marker on the principle of the Einthoven string galvanometer, in which the self-induction and inertia were much reduced, and the time-lag was extremely small. Among other instruments, he designed apparatus for breaking two electric contacts at short intervals apart, and many useful instruments for teaching.

Like so many of the best experimenters, he made with his own hands much of the apparatus he wanted for research, and his skill allowed him to use the simplest means to get good results. Some of the more elaborate instruments, however, were made by the Cambridge Scientific Instrument Company, and he often discussed the designs with me, as Chairman of the Company and as his personal friend. This was always a pleasure; he knew what the instrument should do and how the parts should be made, and his quickness in realising the difficulties, and in seeing improvements in a mechanical design, was most striking. Sometimes I felt proud that I was able to improve the work of such a master of the art of design. If this happened to be the case, his quickness and fair-mindedness made him realise the fact at once. If it were not so, he very soon proved that he was

right. All he wanted was to get the best out of whatever work he was doing; it was the good quality of the work he cared for, not any personal credit in connection with it. This tendency to think of his work and not of himself was appreciated at the Royal Aircraft Factory, and is described in the 'Court Journal' of October 20, 1916, where the writer adds: "I wish there were more like him in that way."

When the war broke out he at once became a volunteer, and did useful work in patrolling the road to Newmarket on a motor bicycle. He then passed the medical examination for the Honourable Artillery Company, and was about to enlist as a private in the infantry battalion. Just then I happened to meet him, and realised at once that his value to the country would be far greater if he worked at the Royal Aircraft Factory, and a telephone conversation with Colonel O'Gorman, Superintendent of the Royal Aircraft Factory, the same day, removed all doubt, and he began work at once.

His scientific training and attainments, his knowledge of the manufacture of scientific instruments, and his remarkable powers of design and research, enabled him to do most valuable work there. Colonel O'Gorman, C.B., Keith Lucas' commanding officer, and Superintendent of the Royal Aircraft Factory during the two years he worked there, writes:—

"Shortly after the outbreak of war, amongst those who flocked to the colours was Keith Lucas. He was a straight, well-knit man, slender, but active, with a body exceptionally finely controlled by an energetic mind. He was young for the manifold scientific honours which distinguished him, but he was so far from over-appreciating himself that at one time he was about to enlist as a private. But, instead of this, he was able to use his rare scientific abilities in improving military aeronautics.

"By a lucky chance, I had the opportunity of giving him work at the Royal Aircraft Factory after he had passed the medical examination for the Honourable Artillery Company.

"I had previously met him when staying in Cambridge, and had heard him discuss questions of mechanical design. This was enough to leave no doubt of his utility, and I seized the suggestion of his joining the Royal Aircraft Factory.

"For Lucas this meant leaving his home at Cambridge, and giving up his original scientific work in Physiology, which was the dominant and all-absorbing interest of his life.

"He arrived at the Royal Aircraft Factory on September 4, 1914, and after living at Fleet for some months, took up his residence in the little wooden hut, 12 feet by 10 feet, which was the only possible means of being housed in the crowded neighbourhood, where workpeople were sleeping as many as 11 in a six-roomed cottage, or using in pairs, for alternate day and night work, the same beds. To be near his work was essential, as in summer he was often flying at dawn.

"He was entrusted with one problem after another in rapid succession, while, simultaneously with this, he held himself open to be consulted, and was constantly consulted, on numerous problems.

"The Experimental Research Department was evidently the place where his abilities would have scope, and there he took up his work. This was the department which had so lately been presided over by Edward Busk, a distinguished graduate of King's College, Cambridge, with whom were associated a number of other Cambridge men, with whom Lucas enjoyed working.

"In breaking new ground of the kind to be dealt with in this department many of the steps meant making measurements of quantities which had never before been measured, and in this he must have found a link with the analogous difficulties in his own study of Physiology. Methods had to be evolved, and instruments to be designed and made. Here Lucas excelled, and in the instrument shop, under Mr. F. Short, he was welcomed and honoured by staff and mechanics alike.

"It chanced that the problem of how to make an accurate sight for dropping bombs from aeroplanes was under consideration shortly after Lucas came. He worked at this, and the seed has been sown which will greatly improve the aeroplane as an offensive weapon.

"On the way to his solution, by means of the gyroscope, he evolved his 'space damped pendulum,' which is in large measure free from the effect of the movements and oscillations which the aeroplane imposes on everything within it. This was a simple device, which avoided the complexities attendant upon the use of gyrostats, and one of its practical outcomes was a new instrument, an aeroplane level, of considerable use in a number of further experiments on aeroplane flight.

"The trend of all this work indicated how necessary it was to obtain an autographic record of the movements, of roll, pitch, and yaw of an aeroplane, both when the pilot abandoned all control, and also when the pilot exercised his utmost vigilance in correcting all deviations. This Lucas was asked to do; he completed a method outlined for this purpose by Mr. Busk, and simplified it. He worked hard, rising day after day at four in the morning for flights when the air was at its stillest and sun low, and, in conjunction with Captain Mayo and Major Goodden, eventually produced a beautiful series of curves of motion which were sent in to the Advisory Committee on Aeronautics, and were received with marked approval.

"With these data, he now knew what classes of erratic motions he had to deal with, when either the flyer or the wind gusts interposed to upset or alter the aim taken with his bomb sight.

"By this time he had decided that the use of the more complex gyrostat could not well be evaded in favour of his simpler scheme of the 'space damped pendulum.' He adopted a suggestion of Major Hopkinson, F.R.S., who had also been for some months a member of the Royal Aircraft Factory staff, and made an improved bomb sight.

"A new and somewhat startling difficulty had been found in connection with aeroplane compasses. Fliers, lost in the fog or cloud and persisting in what they thought was a careful compass course, would find themselves facing in a direction opposite to that in which they believed they were—they would come out of a cloud where they went in without having deviated from a compass course which should have taken them straight through it. This was given to Lucas to solve. He first found the causes of the erroneous indications, and then made a compass in which they were greatly reduced; and his 'space damped pendulum' inspired one part of the remedy. A portion is due to Mr. H. Darwin, F.R.S.

"Lucas was a master of clear and lucid exposition, so that, though he was not always easy to draw into any long dissertation, if he once decided to state a case, there was no loophole for misunderstanding him.

"On the formation of a Territorial Unit of the Royal Flying Corps recruited from the employees of the Royal Aircraft Factory, Lucas was one of the first to be approached by myself, as officer in command, with a view to his taking command of a Park—roughly, 400 men. He willingly consented to take the additional work and responsibility. He was gazetted Captain on December 1, 1916, and appointed to the command of No. 3 Park. He threw himself whole-heartedly into his military duties, and this was soon reflected in the discipline of his command.

"He was essentially a popular officer, and this in a military sense. His men had implicit confidence in his ability to lead them, and no greater tribute is needed.

"I invited him to be the first mess president of the officers' mess, and he retained this office till his death. He had a good influence over the younger officers, and his loss will be greatly felt.

"He was a regular attendant at the Commanding Officer's lectures, and in his own lectures on technical subjects no officer held the attention of his audience on seemingly dry subjects so perfectly as Lucas. His clear style and unusual form of wit made his subject interesting to the latest promoted non-commissioned officer.

"His request to be allowed to learn to fly was granted, and he went to the Central Flying School, where he acquired the art remarkably quickly. He never had a mishap until the fatal collision in the air, when the air-screw of the other aeroplane struck him. He was undoubtedly killed instantly."

Colonel O'Gorman has pointed out the value of Lucas' work on aeroplane compasses. An error, which we will call "the turning error," had often been noticed on aeroplanes. When an aeroplane turned to the right or the left the compass did not indicate the magnetic north correctly. He not only found the cause of this error but designed and made a compass which reduced the error to a great extent. It was, however, a disappointment to him that he was not able to eliminate the error completely. The first difficulty to be

overcome was to find out why the error was capricious ; sometimes it showed itself and sometimes it did not, and it became clear that although it depended on the rate of the turn, it also depended on something else. After much flying and observation of a compass in the air, he found that this error was very great if a deviation was made when the direction of flight was towards the north. In this case the compass needle was so far carried round with the aeroplane, when on a turn, that the flier might think he was flying in a straight line, although he was turning somewhat rapidly. In a cloud, or at night when there were no visible objects to act as guides, this was a great danger. If the aeroplane was flying in a southerly direction the compass needle turned in the opposite direction, and the flier would get an exaggerated estimate of his rate of turning. As the flier's object is to fly straight through a cloud this would not matter.

The abnormal behaviour of the standard compass in the air was utterly unexpected, and the value of the discovery was great. In order to remedy this defect, which was found in all existing compasses, much experimental work had to be done in the air ; he formed theories of the cause of the error, tested them in the air, and after eliminating those which proved wrong, at last found the true cause.

The magnetic forces act on the poles of the magnet in the direction of the dip, and tend to rotate it in a vertical plane. When the aeroplane is flying straight this tendency is balanced by displacing the centre of gravity towards the south pole, in order to keep the magnet horizontal. But when the aeroplane is turning the apparent direction of gravity is no longer the true vertical ; the magnetic forces, however, still act in a vertical plane, as before, and this change of conditions produces the turning error.

The compass that Lucas made was a great improvement on the existing patterns. Its special features are the combination of the antivibration mounting ; the spherical bowl to contain the liquid ; a magnetic system small in relation to the size of the bowl, with a long period of vibration ; graduations on a short cylinder instead of a disc ; and the inverted pivot.

Unknown to Lucas, most or all of these features had been tried before for marine compasses ; but they are not called for at sea, owing to the relatively slow speed of ships, and had been long forgotten. By his work he brought them into use for aeroplane compasses, and they are an important life-saving factor.

One of the reasons why vibration causes errors in compasses was pointed out by Mr. A. Mallock to the Advisory Committee for Aeronautics, and it fell to me to be of some little assistance to Lucas with regard to this error. Theoretical considerations showed that this vibration error would be reduced by inverting the usual arrangement in compasses in which an agate cup is carried by the card and rests on a needle-point fixed to the compass bowl. If the needle-point is fixed to the magnetic system and the agate cup is supported by the compass bowl the vibration errors were reduced. Lucas looked into the theory of the vibration error, confirmed the experiments I

had made, and adopted the inverted point support, and it is a great satisfaction to me to have been of some use in this improvement.

Many of Keith Lucas' friends heard, with regret, that he was learning to fly. In addition to their personal affection they felt the possible loss to science owing to the risk he was running; they also thought that the advances he was making in aeronautics were so important that no chance of interruption by an accident should be taken. But it was questionable whether the risk was increased. Before he learnt to fly he had been in very many flights on an aeroplane as a passenger when he was experimenting with various instruments, and for this work it was essential that he should be a passenger. When flying as a passenger an accident might happen through want of skill of the pilot; when he was a pilot his own want of skill might cause an accident, but those that knew him felt sure that when he had once learnt to fly, he would have far more than the average skill in manipulation of an aeroplane, requiring as it does a clear cool judgment and rapid co-ordination of muscles and brain. He thought he could do his work better by becoming a pilot, and improve the technical part of the branch of the service to which he belonged, and he was right.

Flying as a passenger gave him great pleasure, even on the first occasion. But the pleasure in his first flight alone—his instructor left behind—was far greater still, and he met his death swiftly and suddenly in the open air doing the work he loved. He was buried in the Military Cemetery at Aldershot.

HORACE DARWIN.

## PART II.

Although the physiology of muscle and nerve, and the nature of the excitatory process which passes along such tissues in the form of a wave from a stimulated point, had been subjected to investigation by a large number of workers, it is remarkable how little advance had been made since the time of Helmholtz and Du Bois-Reymond. An occasional fact of importance was discovered from time to time, but it was not until Keith Lucas commenced his systematic study of the process in 1903 that any rapid progress took place. In his first paper, which was devoted to the question of the effect of tension on the duration of muscular contraction, we find from the outset how great a part the design of appropriate and accurate instrumental aid was to play in the elucidation of the various problems attacked. It was by the elimination of the inertia of recording levers by the use of a photographic method that it was shown that increase of tension, within limits, results in a lengthening of the period of contraction. This fact, at a later date, was destined to play an important part in the theory of muscular contraction.

Gotch had already obtained results which indicated that the different degrees of contraction which a muscle is able to exert were due to the varying number of individual fibres at work, and not to the capacity of each fibre to contract otherwise than to the maximal extent within its power at the

time. Keith Lucas brought forward convincing evidence that Gotch's contention was correct, in that the number of degrees of contractile stress possible for a muscle to manifest is not greater than the number of nerve fibres supplied to it. In a subsequent paper, description is given of experiments on a muscle whose nerve contains only eight or nine fibres. In this case, the nerve itself was stimulated. Thus the contraction of voluntary muscle was brought into line with that of the heart and Bowditch's "all or nothing" law shown to apply. Still later, Adrian, a pupil of Keith Lucas, was able to extend the law to the nerve fibre itself, by the use of an ingenious method to be referred to below.

The next step in the theory of contraction was to show that the wave does not change in magnitude during its passage, so far as normal muscle is concerned, although it may suffer diminution in fatigued muscle.

An important series of papers claims our attention at this stage, a series which may be said to have their starting point in the observations of Waller that the amount of energy required to stimulate a nerve varies with the rate at which this energy is applied. Different nerves have a different "characteristic," due to the natural rate of movement possessed by some constituent, which rate controls the effective taking up of the incident energy. Keith Lucas' first experiments were made, as were those of Waller, by the use of condensers of adjustable capacity, charged to different potentials. Subsequently, it was found better to use as index the potential required with currents of varying durations, a factor related to the former in a definite way, since the energy is expressed by  $v^2t$ , where  $v$  is the potential and  $t$  the duration of a current. Similar results were obtained with a simple apparatus designed to vary the rate of increase of an applied current. The methods described were utilised in the analysis of complex excitable systems, such as the sartorius muscle with its nerve. It was found that the muscle has two distinct optimal rates of incidence of energy, one of a very much greater magnitude than the other. This statement still held after sufficient curare had been given to abolish the effect of stimulation of the nerve trunk, so that there must be some additional excitable substance situated between the nerve and the muscle. By testing a part of the muscle free from nerve endings, it was found that the low rate belonged to the muscle fibre itself. The nerve trunk was found to have an optimal rate rather higher than that of muscle, while the intermediate substance had an extremely high rate. The form of the curve expressing the time-course of the relationship between duration of current and potential required to excite, as the muscle changes after excision, was shown to be altered by the presence or absence of calcium. This fact was brought into relationship with Nernst's theory of excitation, to which more attention was given later.

Another property of excitable tissues which is connected with the time-factor in question is the summation of two stimuli, each just below effective strength. If the excitatory process set up by the first stimulus has not disappeared when the second arrives, there is summation. So

that the fact depends on the rate of subsidence, or, in the terms of Nernst's theory, on the rate at which the concentration of ions brought about by the exciting current is again dissipated by diffusion. A further outcome of this point of view was the analysis of various excitable tissues in the light of A. V. Hill's modification of Nernst's theory, in which account is taken of the distance between the membranes at which the ions concerned are supposed to be concentrated and of the diffusion constants of these ions. The time-factor turned out to be in reality conditioned by these two components of the expression deduced by Hill. An interesting point, as yet not explained, is that the rates of movement of the ions in different excitable substances differ more than those of the ordinary inorganic ions known to be present.

Since the rate of the excitatory process should be increased by rise of temperature, it was natural to bring the different effects of temperature on the apparent excitability of muscle and nerve to constant and induced currents into connection with their optimal rates of incidence of energy. The explanation was found to consist in two opposite effects of fall of temperature. A fall of temperature means, on the one hand, a greater ease of the production of the necessary concentration of ions, owing to the decrease of opposing diffusion, while, on the other hand, the actual initiation of the propagated disturbance is more difficult. The resultant effect varies according to the duration of the current required to excite a particular tissue.

The temperature coefficient of the rate of conduction in nerve was measured by Keith Lucas, using an extremely accurate method. It was found to be 1.79 for the 10 degrees between 8° and 18° C.

For further progress it was necessary to make use of the electrical change in excitable tissues as indicating the excitatory process. For this purpose an improved form of capillary electrometer was invented, together with apparatus for measuring the curves for the purpose of analysis. It was first shown that the temperature coefficient of the rate of conduction in excitable tissue is the same as that of the time of development of the electrical disturbance. Hence there is no difficulty in taking this latter as the basis of propagation of the excitatory state, although no proof of their identity is given thereby.

The next series of papers are devoted to the refractory period which follows an effective stimulus. It was shown that the time which elapses before an electrical change shows itself, when it is due to a second stimulus following a previous one, is constant, although the time after the end of the refractory period at which the second stimulus is given may vary considerably. This fact suggested the name "irresponsive period" for the interval between an electric response and the earliest possible succeeding one. This delay occurs also in ventricular muscle, and is due entirely to a modification of the tissue by the preceding propagated disturbance, and not to any direct effect of the current used for stimulation. In conjunction with his pupil, Bramwell, Keith Lucas next showed that the decrease of

excitability after an effective stimulus is due to the passage of the propagated disturbance itself. This refractory period is, in fact, independent of whether the two stimuli fall on the same point or on different points.

A peculiar phenomenon, known as Wedensky's inhibition, also found its explanation in Keith Lucas' work. It was shown to be due to a resistance to conduction in the nerve greater than normal, and the possibility of similar conditions in the nerve centres was discussed as a probable basis of some inhibitory phenomena.

A further step was taken, in conjunction with Adrian, towards the analysis of the process of stimulation, in that this was shown to consist of two stages, a purely local effect and a propagated effect. The former may be present, although insufficient to set in motion a propagated disturbance, and the fact that it does not immediately disappear renders possible summation of stimuli, each in itself an inadequate one. An important method was developed for the estimation of the magnitude of a propagated disturbance, as referred to above. This consisted in determining the distance travelled through a region in which it is progressively diminished in magnitude, that is, a region of decrement, such as is produced by anaesthetics. This method was afterwards applied by Keith Lucas himself to the decision of the important and disputed question as to the possibility of distinguishing between conductivity and excitability in nerve, a distinction which, it had been stated, could be made out by the use of alcohol as a narcotic. The two factors were shown in reality to disappear together, and this disappearance to be due to the same cause, namely, increased difficulty in setting up a propagated disturbance. It was also found that, when such a nerve impulse is set up by a strong stimulus in the "relative" refractory period, it is smaller in magnitude than the normal one, produced by a stimulus outside the refractory period.

The Croonian Lecture was given by Keith Lucas in 1912, and was devoted in part to a discussion of the work referred to in the preceding pages, and to the investigations of other workers on questions related to it. The Lecture concluded with a more detailed description of the modified form of Nernst's theory of excitation, and with criticism and suggestions concerning it.

In a valuable paper on "Summation in the Claw of the Crayfish," published in the 'Journal of Physiology' after the author's death, some of the facts previously discovered are made use of to elucidate the complex problems of this interesting neuro-muscular mechanism. By application of the law governing the relation of current strength to the time of closure required to stimulate, it was found that there are two sets of nerve fibres in the nerve to the claw. One of these is responsible for a slow prolonged form of contraction, the other for a brief quick twitch. It was also found that the type of summation described by Richet was due to the fact that the first stimulus, although sending an impulse along the fibre, fails to cause contraction because it has been reduced in intensity by having to pass through

some area of decrement on its course, probably at the synapse of the nerve fibre with the muscle fibre. A second stimulus, however, applied to the nerve during the period of increased excitability following the previous stimulus, produces a disturbance of sufficient magnitude to pass the obstruction, and contraction of the muscle results. This period of super-normal excitability, succeeding the relatively refractory phase, is more strongly developed in the crayfish than in the frog.

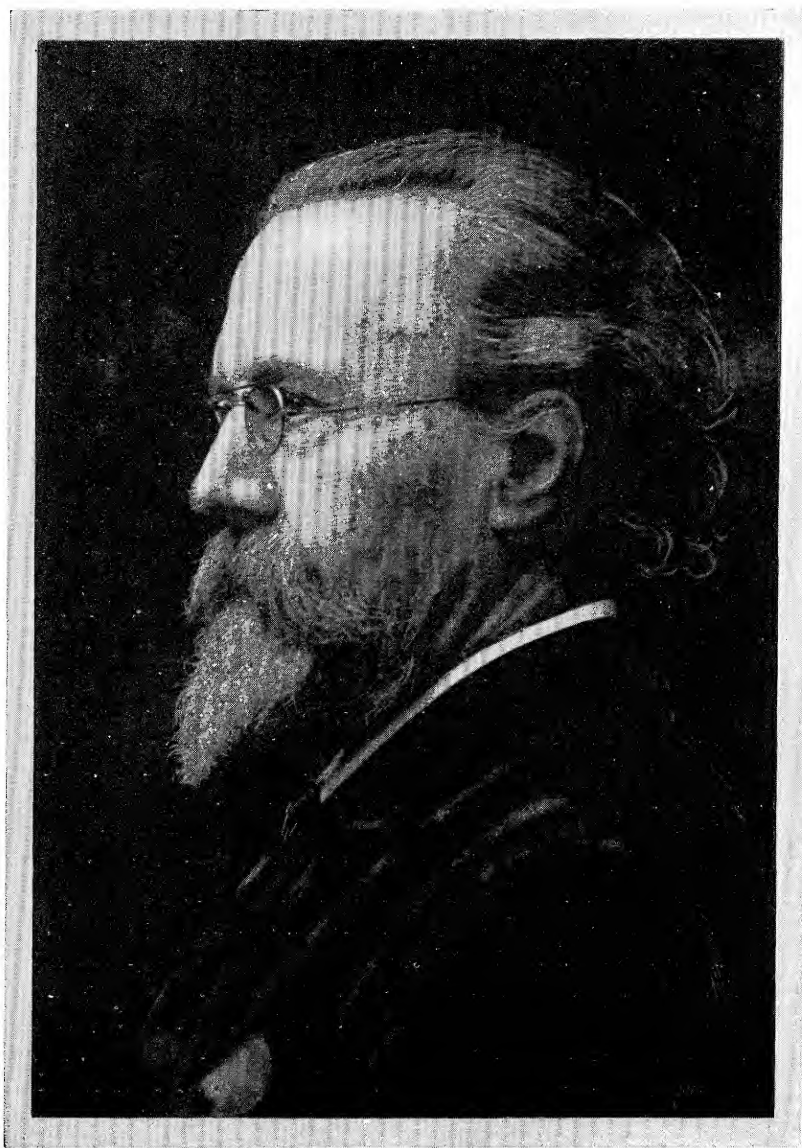
In a footnote to this paper, reference is made to some experiments on the phenomena of inhibition and of tonus shown by the muscles of the crayfish claw. It is much to be hoped that notes of these experiments may be found sufficiently detailed to enable them to be published.

Early in 1914 Keith Lucas gave the Page May Lectures at University College, London, choosing as his subject the phenomena of conduction in nerve. At the outbreak of war, the greater part of these Lectures had been written out for publication as one of the monographs of Prof. Starling's series. After the author's death, the manuscript was revised and completed by Captain Adrian, and the Lectures, which give an excellent summary of the knowledge gained in this field, for the most part by the work of the author and his pupils, were published towards the end of 1917.

It will be seen how great a loss physiological science has sustained in the death of so ingenious and talented a worker at so early a stage of his work. Many further and fundamental advances would undoubtedly have been made if only these researches could have been continued.

W. M. BAYLISS.

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W. L. Linnell.

## HENRY GEORGE PLIMMER, 1856-1918.

HENRY GEORGE PLIMMER was born in 1856, and was the son of a doctor enjoying a good practice in Wiltshire. He always believed that it was from his father that he inherited his love of music, but the country doctor did not transmit to his son that love of sport of all kinds which was so firmly implanted in himself, and unfortunately helped to account for the circumstance that on his death, which occurred when the boy was about nine years of age, he left his family with but slender resources. It was owing to this that young Plimmer entered business in 1870, being engaged as a clerk in a company with which his maternal uncle was concerned. These do not seem to have been very happy days, for the youth was dissatisfied with his outlook and prospects, and felt he was destined for other things. His musical talent, which grew with his growth, was developing rapidly at this period, and he used to tell of the joy with which he had access to the church organ, and of the musical festivals at Birmingham and elsewhere that he attended. He was also already laying the foundations of that wide knowledge of literature which distinguished him in after life, and he numbered Ruskin among his correspondents even at that time.

He finally determined to abandon a business career and to enter the medical profession, and his chance came as the result of a letter to Dr. J. H. Galton, a man who had formerly been, for several years, his father's assistant. In 1878 he came to London as an "unqualified assistant" to Dr. Galton, and thus got his foot on the lower rungs of the medical ladder.

The work was hard, but he had plenty of grit, and by dint of strenuous exertions on his own part he became qualified in 1882 as L.S.A. and in 1883 as M.R.C.S.

In the meantime he had not neglected his other opportunities. He had acquired a good knowledge of French and German, and had already visited both Germany and Belgium. In 1885 he entered into partnership with Drs. Turner and Galton, but in 1892 he retired from practice in order that he might devote himself to Bacteriology and kindred research. In October, 1892, he published an account of some admirable observations he had made on Cancer, and first described those cell inclusions which have come to be known as "Plimmer's bodies." These researches brought him into immediate contact with Armand Ruffer, who suggested that they should work together in the laboratories of the College of Surgeons and Physicians. To this proposal Plimmer agreed, and their association continued almost till 1894, when Plimmer was appointed as Pathologist to the Cancer Hospital. The friendship between the two men lasted until the death of Ruffer, who perished at sea during the war. A felicitous tribute to Ruffer's memory and work appeared in *'Nature'* (1917), written by his friend, who was himself so soon to pass away.

In 1898 he became Bacteriologist to St. Mary's Hospital, and in the next

year was appointed Pathologist and Lecturer on Pathology in the same institution. He resigned his appointments at St. Mary's in 1902, and undertook the direction of the Cancer Laboratories at the Lister Institute.

Meanwhile he had become interested in Trypanosomes, the organisms which produce Sleeping Sickness. In this connection his unrivalled skill in microscopic technique stood him in good stead. He was the author of a number of papers on this subject, and he became an active member of the Tropical Diseases Committee of the Royal Society.

In 1907 he extended the sphere of his pathological work by assuming the duties of Pathologist to the Zoological Gardens, which afforded him additional opportunities of gaining valuable experience. He held this appointment for ten years, finally resigning it as a protest against certain administrative changes of which he felt himself unable to approve. Plimmer communicated the results of his investigations in a considerable number of papers which appeared in various medical and scientific periodicals both at home and abroad, his work for the most part relating to Cancer, Trypanosomes, and kindred subjects. He was elected to the Fellowship of the Royal Society in 1910, and always displayed a keen interest in everything that concerned its welfare. Amongst the valuable services he rendered to the Society, one is especially deserving of mention. He undertook and carried out the overhauling, sorting, and cataloguing of the valuable engravings in the possession of the Society, a work of no small magnitude. It was fortunate, indeed, that the task, which to him was a labour of love, should have fallen into such judicious and capable hands. It was largely owing to his energy, and to his wide knowledge of matters pertaining to art, that so magnificent a series of portraits have been made accessible, with a convenient index, to the Fellows.

A Chair of Comparative Pathology was founded for a term of years at the Imperial College of Science and Technology by an anonymous donor, and Plimmer was appointed to fill it. He held this post until his untimely death in June, 1918. During his tenure of this Chair he delivered a remarkable series of lectures on Immunity, a branch of research in which he had long been keenly interested. He had been on terms of personal intimacy with the chief of the great Continental workers in this subject, from Pasteur onwards, and his brilliant exposition will long be remembered by those who were privileged to listen to him. As a teacher he was remarkably successful. His unusual cast of mind, his wide and varied knowledge, together with a singular personal charm, combined to exert a strong influence on the students who were so fortunate as to come into contact with him. Behind the professor there was always the kindly sympathetic personality of the man himself, who was richly endowed with wisdom in those things which really matter in life.

He had, for some years before his death, taken a prominent part in the administration of various learned societies. He was President of the Royal Microscopical Society in 1911-12, and he served on many scientific committees both at home and abroad. On the outbreak of the war he at once

placed his services at the disposal of the country, and was actively engaged in various medical and scientific enquiries arising out of the new conditions imposed by the war. He was a member of the Tetanus and of the Trench Fever Committees, and was strenuously engaged on researches connected with the latter when he was stricken with mortal illness. He held on to his work as long as it was humanly possible for him to do so, and it was a source of great grief to him during his last days that he should not have been spared to bring his investigations to the end, which seemed already in sight.

In 1887 Plimmer married Helena, widow of Alfred Aders, of Manchester. He owed much to the stimulating devotion of his wife, who ever displayed an active interest in all the many-sided activities of his life, for he was not a scientific man only, but possessed an unusually extensive knowledge of art, literature, and especially of music. As a musician, indeed, he was in the very front rank in respect of his powers both of interpretation and execution. But his intimate friends, whether scientific or otherwise, perhaps will think of him most of all as a loyal and dear friend never to be forgotten, and one of whom it may truly be said, in the words of the poet whom he loved so well :—

*Non omnis moriar, multaque pars mei  
Vitabit Libitinam. . . .*

J. B. F.

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## ALFRED MERLE NORMAN, 1831-1918.

THE REV. CANON NORMAN, M.A., D.C.L., Hon. LL.D. (St. Andrews), F.R.S. F.L.S., began his long and energetic career on August 29, 1831, at Exeter peacefully closing it at Berkhamsted, October 26, 1918.

Of his routine education at Winchester and at Oxford, where he took his degree from Christ Church, there is nothing special to record, though it is of interest to know that he studied Entomology at school, and the Mollusca of Oxfordshire while at college, and that in still earlier years his attention had been directed to Botany by his elder brother, who subsequently met an untimely death when Chief Justice of Bengal.

The interval of two years before his ordination at the age of 25, was spent at the island of Cumbrae, and it was probably this that stamped upon his future life a predominant, though not exclusive interest in Marine Zoology. For some years, indeed, his working hours must have been well filled with the business of his profession. This he never neglected, although in 1866 by becoming a rector he had thenceforth more the control of his own time. In his coal-mining parish of Burnmoor there was opportunity for interesting experiences, of which a sample is worth giving. Among the miners of his congregation he asked an influential friend whether he could not induce a particularly rough-looking mate to attend the services of the church. The appeal was successful, and the recruit, though unable to read, was seen to follow what he heard with earnest attention. Unfortunately, some time later the devotee appeared in a very disordered condition, which his neighbours attributed to his having had a drunken quarrel with his wife. Norman expostulated with him and the man expressed sorrow at what had happened. In time it turned out that it was the wife who had been drunken and inflicted the damage, which the husband was too chivalrous to assign to its true cause. Later on this good fellow was brought to his death-bed by a colliery explosion, and his dying whisper was: "I waited patiently for the Lord, and He inclined unto me, and heard my calling. He brought me also out of the horrible pit, out of the mire and clay, and set my feet upon the rock, and ordered my goings. And He hath put a new song in my mouth, even a thanksgiving unto our God."

On the scientific side of his avocations we find Norman associated with Gwyn Jeffreys, Professor McIntosh, H. B. Brady, G. S. Brady, Hancock, Spence Bate, and other naturalists of repute, not in holiday rambles, but in resolute and sometimes very difficult and arduous work. From 1861 onwards his papers show him dealing with the results of dredging in northern waters, so that in 1868, in the 'Shetland Final Dredging Report,' Part II, his share is "On the Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Hydrozoa, and Porifera," invertebrate groups which few specialists would care to tackle collectively. In those days, it is true, the literature of all branches was not so crowded as it has since



A. M. Norman

become; but it was even then extensive, and not so very easy for a country clergyman to consult, much less to have at home in his own library. Later on, referring to this period, Norman spoke of the keen pleasure with which a necessary book was then acquired as compared with the unemotional acquisition which was a matter of course to a replenished purse.

Acquaintance with the present writer, which quickly ripened into intimacy and abiding friendship, was invited by a letter from Norman, as follows:—  
“Burnmoor Rectory, Fence Houses, Co. Durham, May 6, 1872. Dear Sir, We have so few carcinologists that it gives me great pleasure to welcome an addition to their number,” with other obliging remarks. It will be easily understood how encouraging was such a notice from an acknowledged authority of long standing to one who was then a neophyte in systematic Zoology, in every need of experienced help and guidance, and little suspicious of the necessity for sifting good work from bad done by pioneers in all departments. After much intervening correspondence, in 1875 Norman was attracted away from his favourite northern seas to spend his summer holiday in Devon, receiving a welcome in Torquay on his way to Salcombe, the classic hunting-ground of Colonel Montagu. To attain this goal, instead of making the comfortable and picturesque journey by land, he carried his dredging apparatus on board a Brixham trawler, with the result that, on his applying for accommodation which had been recommended to him at Salcombe, the scared landlady would have no dealing with so disreputable-looking a visitor. Too late her penitent eyes recognised in the rejected lodger a scrupulously well-groomed parson. To such mishaps or misunderstandings enthusiastic nature-students cannot help being exposed. A more inconvenient trouble occurred at a later date. The sorting of miscellaneous specimens brought up by the dredge is often rather uneasy work on land; much more trying is it on board a small vessel out at sea. It is useful, therefore, to have a series of graded sieves, so that the minuter forms, which are sometimes the most important, may be readily separated from those of coarser build. To fit these one into the other for compactness in travel the uppermost with the largest mesh will have the smallest diameter. On one occasion Norman, just ready to start on his brief holiday, found that the constructor of this apparatus, instead of following instructions, had followed his “common sense,” which taught him that the largest sieve should have the largest mesh, and that the smallest mesh naturally belonged to the smallest sieve. Unhappily, this theoretical improvement caused a very annoying delay while it was being reversed in the interest of practical convenience.

Though he published numerous treatises independently, Norman loved to associate himself with other naturalists in publication, fully as much to their advantage as to his own. Only on one occasion did this lead to any misunderstanding. The highly important ‘*Monograph of the Marine and Freshwater Ostracoda of the North Atlantic and of North-Western Europe*,’ by Brady and Norman, of which the first part was published in 1889, had been awaited with keen and pleasurable expectation by another colleague.

This was David Robertson, "the Naturalist of Cumbræ," who, with absolutely no initial advantages, had become a successful man of business, an ardent zoologist, and an exceptionally acute observer of marine life. When the work appeared, to which he had given unstinted (though not literary) service, his name was missing from the title-page. Notwithstanding his genial and modest temperament, the disappointment was perhaps never quite cured, though substantially solaced later on when the University of Glasgow made him an honorary Doctor of Laws. Generally, Norman was ready enough to give praise where it was due, as when he denominated the Norwegian Prof. G. O. Sars "the prince of carcinologists."

Among the distinctions which Norman himself held, it may be noticed that he received from the Institute of France the medal struck in honour of the exploring expeditions by the "Talisman" and the "Travailleur" in the Bay of Biscay. These he had joined by the invitation of the French Government, and his varied knowledge of oceanic species made his presence on board those vessels in the highest degree acceptable. When, in 1906, the gold medal of the Linnean Society was awarded him, the President, Prof. Herdman, gave an ample summary of the medallist's services to science, which is on record in the 'Proceedings' of that Society, and need scarcely be repeated here. It may, however, be noted that it begins with the year 1851, when at the age of twenty Norman published an account of the Mollusca of Oxfordshire. Years afterwards it was pleasant to find him President of the Conchological Society, and, while sharing his hospitality to the members, to join them in admiring and examining his noble conchological collection. Besides taking an active part in describing the results obtained by various exploring vessels, Norman was of essential service to Wyville Thomson and John Murray in their business of selecting the army of workers by whom the gigantic Report on the "Challenger" expedition was in twelve years completed. His dealing with the fourth volume of the 'Monograph of the British Spongiadae' was a very unselfish affair, from a scientific point of view, which he thus explains, "In editing this posthumous volume of his valued friend, his aim has been simply to leave it as Dr. Bowerbank's work. To have attempted to indicate his own (Norman's) views would have been to remodel the whole, and the species would have had to be thrown into more numerous genera, defined on different principles, while, on the other hand, the number of so-called species would have been considerably reduced." Incidentally, the same preface observes that "a large number of the localities, to which the editor's initial is attached, will be found to be situated in the counties of Galway and Mayo, where a remarkably fine collection of sponges was obtained during a scientific expedition which Mr. D. Robertson, of Glasgow [and Cumbræ], and himself made to that part of Ireland in the summer of 1874."

Tributes to Norman's diversified knowledge are given by the competition for the use of his name in generic terminology. This was started by his friend Prof. G. S. Brady, who in 1866 named a genus of the Ostracoda *Normania*. This, however, a little while before had been named *Loxoconcha*

by G. O. Sars. In 1868, Bowerbank gave the name *Normania* to a genus of sponges, which occupies a rather peculiar position, seeing that Norman, in whose paper Bowerbank's definition is incorporated, himself points out Brady's previous use of the same generic name. In 1870, Axel Boeck chose *Normania* to designate a genus of Amphipoda, but this being evidently pre-occupied, was changed by Jules Bonnier into *Normanion* in 1893. In 1880, Brady had established *Normanella* for one of the Copepoda, and, finally Dr. Harmer, in 'Nature' for November 7, 1918, after referring to the many services to science rendered by Norman, says: "Another of his specially noteworthy discoveries was the enigmatic encrusting organism obtained by him in the neighbourhood of Madeira, and afterwards named *Merlia normani* in his honour by Mr. R. Kirkpatrick."

In 1895 Norman was persuaded to migrate from Burnmoor to the far more important rectory of Houghton-le-Spring. The transfer of his innumerable and precious natural history specimens was a source of considerable anxiety. In his new sphere, besides being rural dean, he needed the help of three or even four curates, and though he delighted in horticulture, a rectory garden of seven acres was almost an embarrassment of riches. After a few years even his robust constitution felt the strain, so that during the present century he has resided at Berkhamsted, in a roomy house such as his library and collections required, but with a more manageable garden for retired leisure.

During this period, after waiting patiently but in vain for further material, from 1887 to 1912, he completed, so far as practicable, his account of the eccentric cirripede, *Synagoga mira*, which has been taken by Gruvel as type of a new family Synagodidæ. How little inclined he was by retiring to lead a life of indolence may be judged by various other publications. Among these is the important volume on the "Crustacea of Devon and Cornwall," in collaboration with Thomas Scott, LL.D., F.L.S. Furthermore, on February 15, 1907, he writes: "I am now engaged in preparing a paper on the Marine Mollusca of Madeira.... My joint report with Brady on the Crustacea of Northumberland and Durham is passing through the post. On April 27 I have to deliver a President's Address for the Herts Nat. Hist. Soc. .... I am thinking of a paper with diagrams of types of freshwater Crustacea in the hope of stirring up some observers in the county. .... I have just been instrumental in starting here a society of literature, science, and art. ... Then there has just been started a clerical book club of which they unfortunately made me librarian." Among the results of his visit to Madeira in 1898, he had already published a short paper on the Land Isopods of that Island. The second presidential address which he delivered to the Hertfordshire Society at Watford, April 25, 1908, gave the inland students of science a refreshing story of maritime exploration, under the heading "The Celtic Province, its extent and its Marine Fauna." During the last few years the necessity for employing an amanuensis checked the flow of his correspondence. But apart from occasional sorrows, it seems true to

say that his whole life was one of happiness rewarding virtue, the conscientious discharge of duty, the zeal for exploring and explaining the secrets of Nature, and the readiness for friendship and partnership in all his pursuits.

T. R. R. STEBBING.

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Clement Reid, 1901

Clement Reid



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